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TECHNICAL REPORT  
NATICK/TR-95/024

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# **FRONT-END ANALYSIS OF LOAD BEARING EQUIPMENT FOR THE U.S. ARMY AND U.S. MARINE CORPS**

by

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13. ABSTRACT (Maximum 200 words) The purpose of this Front End Analysis (FEA) was to conduct a quick but comprehensive analysis of the overall load-bearing requirements of the U.S. Army and U.S. Marine Corps. A unique facet of this project was to provide a draft Statement of Need in addition to the formal technical report. Steps taken to define the requirements for a Load-Bearing system included a market (product) survey of 46 foreign and domestic commercial and military packs, a technical literature review of load-bearing equipment and research, review of past user surveys by Natick and the Infantry School, an FEA survey of approximately 2000 users from five Army locations and two U.S. Marine Corps locations, as well as a two-day workshop with selected users of current load-bearing equipment. Results support the need for two load-bearing systems, one modular and one specially designed for extreme conditions. Key requirements identified involve equipment compatibilities, padding, and features for fitting systems to the population of users. The capacities and features for the modular system are approximately those found on a number of different current pack systems. The main system should be a modular system of varying capacities to accommodate a wide range of users. The second system should be designed for the special added space requirements of extreme cold weather. The data suggest the main pack of the modular system should have a capacity equivalent to the current All-purpose Lightweight Individual Carrying Equipment (ALICE)-large pack plus a detachable assault pack. The analysis revealed a need for a standard load classification and terminology system to facilitate discussions about the requirements for load-bearing systems. Survey findings also indicate soldiers need special instruction on the benefits of using hip support for reducing the strain of heavy loads.					
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## LIST OF ACRONYMS

ADEA	Army Development and Employment Agency
ALICE	All-purpose Lightweight Individual Carrying Equipment
AMC	Army Materiel Command
AMSAA	Army Materiel Systems Analysis Agency
ARI	Army Research Institute
ATD	Advanced Technology Demonstration
BDU	Battle Dress Uniform
CIE	Clothing and Individual Equipment
DCD	Directorate of Combat Development
DRAGON	Man portable anti-armor missile
FEA	Front End Analysis
FM	Field Manual
FPLIF	Field Pack Large, Internal Frame
HEL	Human Engineering Lab now HRED
HRED	Human Research and Engineering Directorate formerly HEL
ITLBV	Individual Tactical Load-Bearing Vest
IV	Intravenous (medical) bag
JOT	Jungle Operational Training
LBE	Load Bearing Equipment
LCS	Load Carrying System
LINCLOE	Lightweight INdividual CLOthing and Equipment = ALICE
M60	Machinegun model M60
MANPRINT	Manpower Intergration
MFPL	Main Field Pack Large
MLS	Modular Load System
MOS	Military Occupational Specialties
MTBOMF	Mean-time-between-operational-mission-failure
NBC	Nuclear, Biological, Chemical
NRDEC	Natick Research, Development and Engineering Center
NTC	National Training Center, Ft Irwin, CA
OFIG	Operational Forces Interface Group (Natick)
OJC	Operation Just Cause (Panama) 1989
PM-Soldier	Program Manager, Soldier
RAM	Reliability, Availability, and Maintainability
RTO	Radio Telephone Operator
SAPPER	Anti-armor personnel
SAW	Squad Automatic Weapon
SINCGARS	Single Channel Ground and Airborne Radio System
SIPE	Soldier Integrated Protective Ensemble
SOF	Special Operations Forces
TLBV	Tactical Load-Bearing Vest (see also ITLBV)
TM	Technical Manual
TOW	Tube-launched, Optically tracked, Wire guided missile
TR	Technical Report
TRADOC	Training and Doctrine Command
TSM-Soldier	TRADOC System Manager - Soldier
USAIS	U.S. Army Infantry School, Ft. Benning, GA
USASOC	U.S. Army, Southern Command
USMC	U.S. Marine Corps
USMCSYSCOM	U.S. Marine Corps Systems Command, Quantico, VA
VIPER	AA Weapon

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## EXECUTIVE SUMMARY

A joint working group was established in January 1985 to evaluate proposed designs of clothing and equipment for use by members of the U.S. Army and U.S. Marine Corps. The program led to the design of two components of a Load Carrying System (LCS), the Individual Tactical Load-Bearing Vest (ITLBV) and the Field Pack Large, Internal Frame (FPLIF). The FPLIF was originally designed as a cold weather load carrying system but it was later decided to make it the replacement for the existing external frame and large pack known as the All-purpose Lightweight Individual Carrying Equipment (ALICE) system. Following initial testing many changes were made before retesting these items and the eventual type classification in 1988 and production in 1990.

Soon after the Army issued the new FPLIF to selected units, problems appeared. To document the problems, the Infantry School conducted a brief survey of the units in latter part of 1993. Most of the problems were associated with poor manufacturing and quality rather than design. While the quality problems probably affected the perceptions of the product, many of the users claimed there were basic problems with the design.

In March 1994 the TRADOC System Manager-Soldier (TSM-Soldier) issued a memorandum calling for the deletion of the FPLIF and the interim use of the ALICE Large already in the system. This was soon followed by a joint call by the TSM-Soldier, the Combat Developer at the U.S. Army Infantry School (USAIS), the Program Manager-Soldier (PM-Soldier, Army Materiel Command (AMC)), and the U.S. Marine Corps Systems Command (MARCORPSYSCOM, Quantico, VA) for initiating a front end analysis (FEA) to determine what the Army and Marine Corps load bearing system should look like.

The purpose of this FEA is to conduct a comprehensive systems analysis of the overall load bearing requirements of the U.S. Army and U. S. Marine Corps and determine the best near-term solution to the current equipment problems. The product of this analysis is a draft requirements document and this technical report with recommendations for the redesign and improvement of the current array of load bearing equipment. The draft requirement statements and technical report include information that will facilitate near-term system design solutions while, at the same time, help in the transition into the longer term soldier system programs. It should be noted that this FEA was directed to consider all personnel with load carrying requirements within the Army and the Marine Corps and not just those with a direct combat mission.

This FEA reviews and analyzes information from past studies and surveys on load bearing, a Load Bearing Equipment (LBE) questionnaire survey of users and "muddy boot" working groups

designed for this effort. Included were a market survey and collection of commercial and foreign military pack systems as well as design concepts from the U. S. Army Infantry School (USAIS), the Army Research Laboratory (ARL) and the Natick RD&E Center (Natick).

The results are presented by the key issues related to the design of a complete load bearing system. In the market survey it was found that many packs on the commercial market have some interesting and promising features for military use but that none meets all the requirements of the military. Some foreign packs also have features that interest the user, but none has all the requirements identified. A prototype evaluated by the Army Research Laboratory offers many important features but is not designed to meet all the requirements. In the FEA survey a large number of users were asked about many features of the ALICE and FPLIF systems and whether they agreed with comments frequently made about them. The findings support the reported concerns about compatibility, fit, comfort, durability and utility of the existing system. The result indicating a need for a flexible, modular system is real. The features and capacities of the packs and pouches in a modular system are a mix between those found in the ALICE large and the FPLIF system, including the detachable assault pack.

The user working groups also reviewed most of the issues under discussion and recommended a modular system as well as retaining and improving the quality of the internal frame as a cold weather system. Durability was also recognized as critical and the groups recommended more stringent testing. In addition to a detachable assault pack, the user groups recognized a need for an optional butt pack in the system for greater mission flexibility. The adjustability of the frame and accommodating different sizes of individuals were identified as requirements of the system. The need that all components of the system be compatible with other equipment worn and carried by the combatant was also emphasized.

In addition to the above findings, the surveys revealed a need to instruct users on the benefits of using hip support for carrying heavy loads and a need for common terminology and a classification system for load configurations among Army and Marine units. A draft Statement of Need for Clothing and Individual Equipment, as requested by the PM-Soldier Office, is provided in this report.

## **Front End Analysis of Load Bearing Equipment for the U.S. Army and Marines**

### **INTRODUCTION**

In January 1985 a joint working group was established to evaluate proposed designs of clothing and equipment for use by the U.S. Army and U.S. Marine Corps. The program led to the design of two components of a Load Carrying System (LCS), the Individual Tactical Load-Bearing Vest (ITLBV) and the Field Pack Large, Internal Frame (FPLIF). The FPLIF was originally designed as a cold weather load carrying system but it was later decided to make it the replacement for the existing external frame and large pack known as the All-purpose Lightweight Individual Carrying Equipment (ALICE) system.

In tests of early prototypes of the FPLIF a number of problems were found including difficulty in accommodating the field radio and sleeping bag and exterior pockets being too small. The ITLBV had durability problems because of the heavy loads and there were some compatibility and adjustability problems with the belt systems and the items that hung from them. Other small details were also noted and changes were made to the LCS. Many changes were made before retesting of these items and the eventual type classification in 1988 and production in 1990.

Soon after issuing the new FPLIF to selected Army and Marine Corps units, problems appeared. In 1993 the Infantry School surveyed the Army units to ask about the problems encountered. Most of the problems were associated with poor manufacturing and quality rather than design. While the quality problems probably affected the perceptions of the product, many of the users claimed there were basic problems with the design, such as the pack being too hot against the back in warm climates due to the closeness of the load to the body (a feature that improves center of gravity and insulates in cold) and discomfort and lack of stability when heavily loaded. Although many of the features of the pack were liked (e.g., the patrol pack was universally liked and many liked the design and size of the main pack and outside pockets), it was felt by many, but not all, units the pack design was not acceptable. While all units had serious problems with the FPLIF, most (six out of nine) favored the option for having both the ALICE and the FPLIF. As with the early problems with ALICE, the FPLIF could not stand up to excessive loads. In addition, the FPLIF was difficult to use during airborne operations.

In March 1994 the TRADOC System Manager-Soldier (TSM-Soldier) issued a memorandum calling for the deletion of the FPLIF and the interim use of the ALICE-Large pack already in the system. The TSM-Soldier deemed it more than a durability problem and called for a redesign of the system. At this point, there was a joint call by TSM-Soldier, the Combat Developer at the U.S.

Army Infantry School (USAIS), the PM-Soldier, and the MARCORPSYSCOM for initiating a front end analysis (FEA) to determine what the Army and Marine Corps load bearing system should look like. Furthermore, since there was an ongoing FEA for body armor, the LBE FEA team was asked to coordinate its effort with the body armor program to assure compatibility.

## **PURPOSE AND SCOPE**

The purpose of this FEA was to conduct a quick but comprehensive analysis of the overall load bearing requirements of U.S. Army and U.S. Marine Corps combat and support units and to determine the best near-term solution to the current equipment problems. The product was a draft statement of needs document and this technical report with recommendations for the redesign and improvement of the current array of load bearing equipment. The draft requirement statements and analysis include information that will facilitate near-term system design solutions while, at the same time, help in the transition into the longer term Soldier System programs. It should be noted that this FEA was directed to consider all personnel with load carrying requirements within the Army and the Marine Corps and not just those with a direct combat mission.

## **APPROACH**

This FEA reviews and analyzes information from past studies and surveys on load bearing, a questionnaire survey of users and a "muddy boot" working group session designed for this effort, a market survey and collection of commercial and foreign military pack systems as well as design concepts from the U. S. Army Infantry School (USAIS), the Army Research Laboratory (ARL) and the Natick RD&E Center (Natick). It was judged that this FEA was possible in spite of the short time available for its execution because it was assumed that the current equipment is a result of numerous user-developer interactions and has undergone a prolonged and gradual evolution.

Today's load bearing equipment has been refined by many changes over the years with numerous contributions from a large number of individuals and groups. Thus, these items contain, in their design, important features that tend to meet the current needs of the services. This means that certain key features such as size and volume are approximately what they should be for the most common loads carried. Thus, whatever changes are needed will likely involve relatively modest, rather than radical, changes.

Many individuals in TRADOC and AMC have recently given the current problems a great deal of thought. In the beginning, the advantage of a preliminary draft requirements document from Ft. Benning, along with that group's user survey on the FPLIF, provided this FEA a good jump start. The FEA team, nonetheless,

adopted the guiding rule that no existing feature, component, or element of current load bearing equipment would be exempt from careful consideration with the potential for more radical change, improvement, or elimination. The main feature of this analysis is that it considered input from a large number of sources and users to obtain a representation of views from many subgroups within the Army and the Marines Corps.

## **ANALYSIS & RESULTS**

The analysis focuses on a list of critical issues for military load bearing equipment that was compiled from numerous sources including the FEA's Executive Steering Committee. Each issue is presented and discussed below using information from reviews and studies conducted during or prior to this FEA.

- A short history of the U.S. Army load carrying equipment since WWII (to be published separately).

- The findings from prior Natick Operational Forces Interface Group (OFIG) sample surveys on load bearing equipment conducted after such missions as Grenada, Panama, and Operation Desert Storm and a number of field training exercises (primarily involving the external framed ALICE LBE).

- Feedback to the Infantry School Commandant's message surveying military units that reported problems with the newly issued FPLIF (internal frame) system.

- Findings from this FEA's questionnaire survey of nearly 2,000 military personnel conducted from June to September 1994.

- Results from this FEA's "Muddy Boot" working groups held during 13-16 September 1994 at Ft. Benning, GA.

Based on the above sources, the following key questions are addressed and data presented to provide answers from a user perspective. Comments are added to help address technical issues or to highlight trade-offs to be considered in the design of a modular load bearing system.

### **1. WHAT LOAD CLASSIFICATION SYSTEM SHOULD BE USED WHEN DISCUSSING THE REQUIREMENTS OF A LOAD BEARING SYSTEM?**

a. Muddy Boot Working Groups: Of the two groups formed during the muddy boot sessions, the first group identified Fighting Load and Sustainment Load and possibly Approach March Load although mechanized units don't have approach marches. The second group could not agree on a classification system in the time allotted. The joint consensus was not to adopt a classification system at this session.

b. Review of load types: Since a common terminology would assist in the discussion of load system design, the



following is an outline of a load classification system adopted by the Army Development and Employment Agency (ADEA) at Ft. Lewis, WA during a "Lightening the Soldier's Load" study in 1986. ADEA introduced a load echelonment concept that delineated different levels of loads for different mission segments. They described three general types of loads: Combat Load, Sustainment Load, and Contingency Load. According to this scheme, the infantry soldier is responsible for his Combat Load, the Battalion for the Sustainment Load and the Division-Corps for the Contingency Load (although, at some points the individual may have to move elements of his own sustainment and contingency loads). The combat load includes items required for the unit to fight from 48 to 72 hours without resupply and is further divided into three categories: Light Fighting Load, Assault Pack Load, and Rucksack Load.

1) Combat Load.

a. Light Fighting Load: This involves items the soldier carries in his hands, the clothing he wears (including the LBE), and whatever he has in his pockets or attached to his belt and suspenders (or vest, if wearing a tactical vest). Items include such things as ammunition, grenades, bayonet, flares, and water; whatever is needed to engage the enemy at the moment.

b. Assault Pack Load: In addition to the above, an assault pack provides room for extra equipment. This load could be shed when in contact with the enemy. It contains extra ammunition, water, food for the immediate mission.

c. Rucksack Load: Carried during the approach march when no enemy contact is expected. The rucksack contains extra rations, water, sleeping bag, batteries and other items needed for extended operations.

2) Sustainment Load. The Sustainment Load has also been referred to as the A-bag. This load is essentially a duffel bag carried by battalion assets and includes items related to threats, chemical and ballistic protection. The individual may have to carry this for short distances during initial deployment.

3) Contingency Load. The Contingency Load involves both the B bag (duffel) and/or a C box (foot locker) carried by the Division/Corps assets and includes primarily extra clothing for conditions anticipated but not immediately encountered.

The ADEA study expanded the previous classification systems by including loads shared by various unit echelons with which the soldier is associated during a particular mission. The study also described essential equipment tied to the types of loads and included such things as vests, packs and load carriers (motorized and nonmotorized) for individuals and small teams. ADEA's study comes closer than most in relating the load carrying equipment to the types of loads carried by the Light Infantry.

c. Comments: A classification system of load types based on military operations would benefit both combat and materiel developers in that it would clarify requirements. The ADEA system is a major step but there is still a need to clarify equipment in more detail and to identify some special support loads while maintaining the ADEA classifications of fighting, sustainment and contingency loads. This could be done by modifying the ADEA system to include some of the special loads found in the user surveys.

## **2. HOW MANY UNIQUE LBE SUB-SYSTEMS ARE NEEDED?**

a. Muddy Boot Working Groups: Group one concluded that most MOS and squad positions need unique LBE configurations. However, particular distinction should be given to the medic, SAPPER (anti-armor), Special Operations Forces (SOF), Squad Automatic Weapon (SAW) gunner and M60 machine gunner and the airborne soldier. The second group concluded there is a need for at least three systems: a versatile modular system, a physician's ruck, and a cold weather LBE system. The joint conclusion was two unique systems: the modular external frame/pack/vest system and an extreme cold weather internal frame/pack/vest system modeled after the ALICE and FPLIF systems, respectively.

b. The LBE Questionnaire Survey: The FEA LBE questionnaire contained a list of 32 statements about the ALICE external frame system to which the respondent indicated either agreement or disagreement. When the responses to these questions were analyzed (correlational analysis) by Military Occupational Specialty (MOS) (see Table 1) it was found that all the Infantry MOS (11 series), the Engineers (12B), and Medics (91B) showed highly correlated patterns of agreement/disagreement on the questionnaire (Table 2). This was true for all but one item in which the Medics indicated an incompatibility between ALICE and the medic's bag. A different cluster of responses was shared by the Mechanic MOS (63 series), Chemical Specialist (54B) and Communication Specialists (31 series). The responses of the Transport personnel (88M) were dramatically different from all the others. These and other data (presented below) demonstrate some potential for unique configurations and the need for special features or components for load carriage.

The questionnaire item that asks whether there is a need for more than one type of load bearing system addresses this issue more directly (Figure 1). Overall, the percentage of those who answered YES was 57% while only 16% said NO (N=1,450).

This issue is also addressed by the questions about "Who in your unit has the greatest loads to carry?" and "What are some of the more difficult items to carry?" (Figure 2). The M60 machine gunner and assistant were listed 35% of the time, the Radio

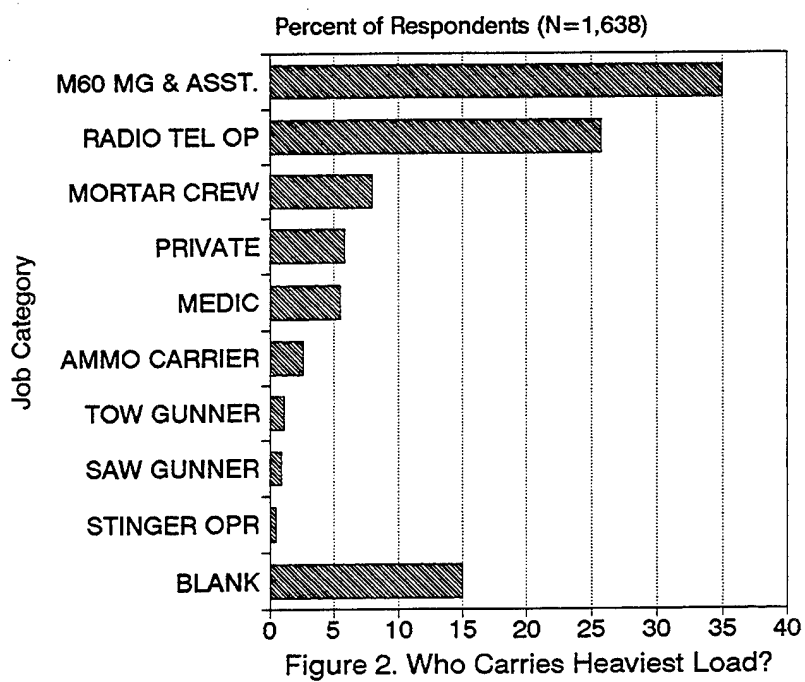
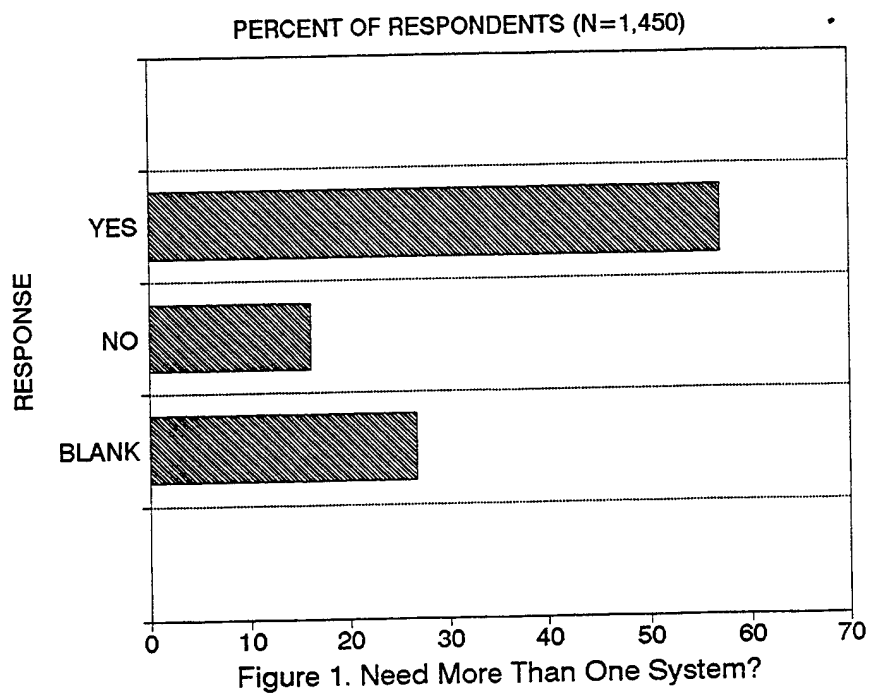
**TABLE 1. Military Occupational Specialties (MOS)**

<b>MOS</b>	<b>TITLE</b>	<b>No. Respondents</b>	
		<b>ALICE</b>	<b>FPLIF</b>
<b>11B</b>	<b>INFANTRY</b>	<b>725</b>	<b>348</b>
<b>12B</b>	<b>COMBAT ENGINEER</b>	<b>180</b>	<b>26</b>
<b>31M</b>	<b>COMMUNICATION</b>	<b>26</b>	<b>11</b>
<b>54B</b>	<b>CHEMICAL SPECIALIST</b>	<b>66</b>	<b>16</b>
<b>63E</b>	<b>ABRAMS MECHANIC</b>	<b>99</b>	<b>16</b>
<b>77F</b>	<b>PETRO SUPPLY SPECIALIST</b>	<b>53</b>	<b>13</b>
<b>88M</b>	<b>MOTOR TRANSPORT SPECIALIST</b>	<b>27</b>	<b>7</b>
<b>91B</b>	<b>MEDIC</b>	<b>104</b>	<b>34</b>

**TABLE 2. Correlation Between MOS on ALICE Questions**

**CORRELATIONS**

<b>MOS x MOS</b>	<b>d.f. = 30</b>	
<b>11B X 12B</b>	<b>0.9738</b>	<b>HIGHEST</b>
<b>63E X 91B</b>	<b>0.9291</b>	
<b>12B X 91B</b>	<b>0.9196</b>	
<b>11B X 91B</b>	<b>0.9173</b>	
<b>12B X 63E</b>	<b>0.9104</b>	
<b>54B X 63E</b>	<b>0.9090</b>	
<b>63E X 77F</b>	<b>0.8983</b>	
<b>11B X 63E</b>	<b>0.8958</b>	
<b>63E X 88M</b>	<b>0.8937</b>	
<b>12B X 54B</b>	<b>0.8914</b>	
<b>11B X 54B</b>	<b>0.8891</b>	
<b>54B X 91B</b>	<b>0.8882</b>	
<b>77F X 91B</b>	<b>0.8836</b>	
<b>31M X 91B</b>	<b>0.8794</b>	
<b>54B X 77F</b>	<b>0.8764</b>	
<b>11B X 77F</b>	<b>0.8678</b>	
<b>12B X 77F</b>	<b>0.8619</b>	
<b>31M X 77F</b>	<b>0.8597</b>	
<b>31M X 63E</b>	<b>0.8567</b>	
<b>31M X 54B</b>	<b>0.8542</b>	
<b>54B X 88M</b>	<b>0.8478</b>	
<b>88M X 91B</b>	<b>0.8387</b>	
<b>12B X 31M</b>	<b>0.8342</b>	
<b>12B X 88M</b>	<b>0.8311</b>	
<b>11B X 31M</b>	<b>0.8177</b>	
<b>11B X 88M</b>	<b>0.8135</b>	
<b>77F X 88M</b>	<b>0.7995</b>	
<b>31M X 88M</b>	<b>0.7173</b>	<b>LOWEST</b>



Telephone Operator 26%, Mortar Crew 8%, Medic 5%, Ammo carrier 3%, SAW gunner and TOW gunner 1% each (N=1,638). It should be noted that many of the positions listed did not represent those surveyed. There were few Medics surveyed, for example, therefore the listing of the Medic is very significant. The list of difficult items to carry include items carried by the above personnel but also some of the items carried by all combat team members, such as night vision devices.

c. User Feedback from USAIS FPLIF Survey: In spite of the many problems with the FPLIF, six of the nine units who were issued the new FPLIF selected the option to have the ALICE as their standard LBE and a smaller stockage of an improved FPLIF for cold weather operations. These units stated that this option would give them greater flexibility to meet their required missions.

d. Comments: There are a number of user groups, including the Marine Corps, who express a need for an internal type frame system, especially for cold weather operations. If the goal of soldier system design is to optimize individual performance (as opposed to optimizing for logistics), then future developments may need to provide the options that better match the performance requirements of widely different combatants, missions, and environmental conditions.

### **3. WHAT TYPE OF FRAME SYSTEM SHOULD THE MILITARY HAVE?**

a. Muddy Boot Working Groups: The joint conclusion was that the military needs both an external type frame system with modular capabilities as the primary load carrying system and an internal frame with a large capacity pack for the unique requirements of cold weather and other special operations.

b. The LBE Questionnaire Survey: Of the 7 units that had individuals with experience with the internal frame pack (FPLIF) (N=408) all 7 strongly agreed (based on average scores) with the positive feature of the sleeping bag compartment, 6 units indicated strong agreement with the statements about the usefulness of the assault pack and the adjustability feature, 5 units indicated the need for the extra room for cold weather missions, and 4 units favored the number and size of the outer pockets found on the FPLIF. These same units also showed strong agreement with the negative statements "Can't Fire Weapon" (all 7), "Fasteners not durable" (6), "Objects dig into back" (5), "Not compatible with carrying 5 gal containers" (5), "Less stable than ALICE" (4), "Too warm in warm weather" (4), "Not compatible with butt pack" (4), and "The FPLIF is not durable" (4). Although these results do not answer the question directly, there is strong positive support for the main features of the FPLIF and a recognition of the need for the extra space afforded by this system for cold operations while indicating at the same time that the ALICE-Large is sized right for their other missions. Looking at Figure 3, the statement "Extra room for cold is good" all MOS groups

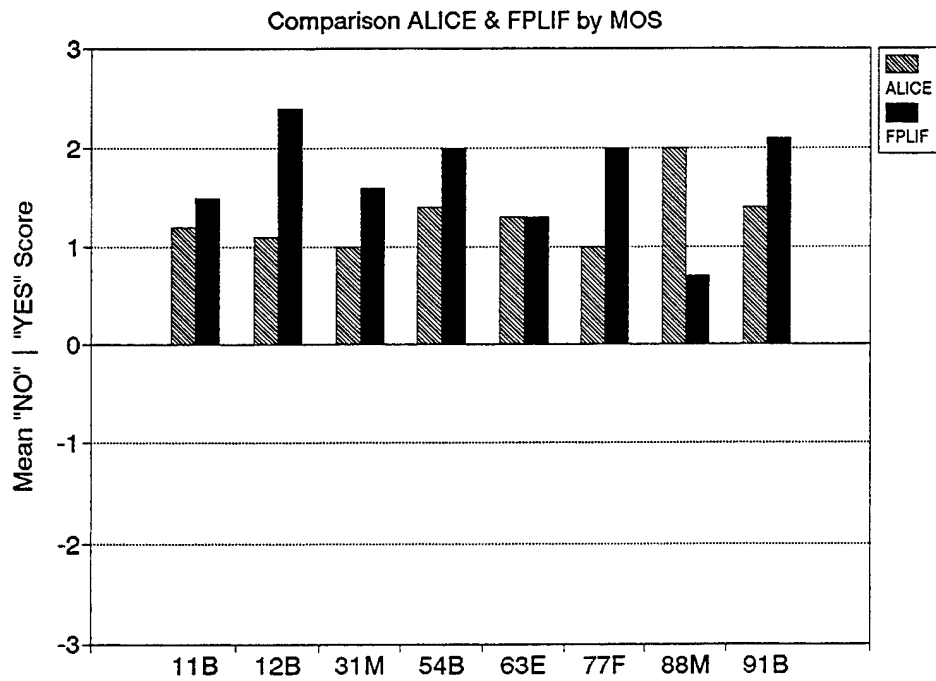


Figure 3. Packs Need More Room in COLD?

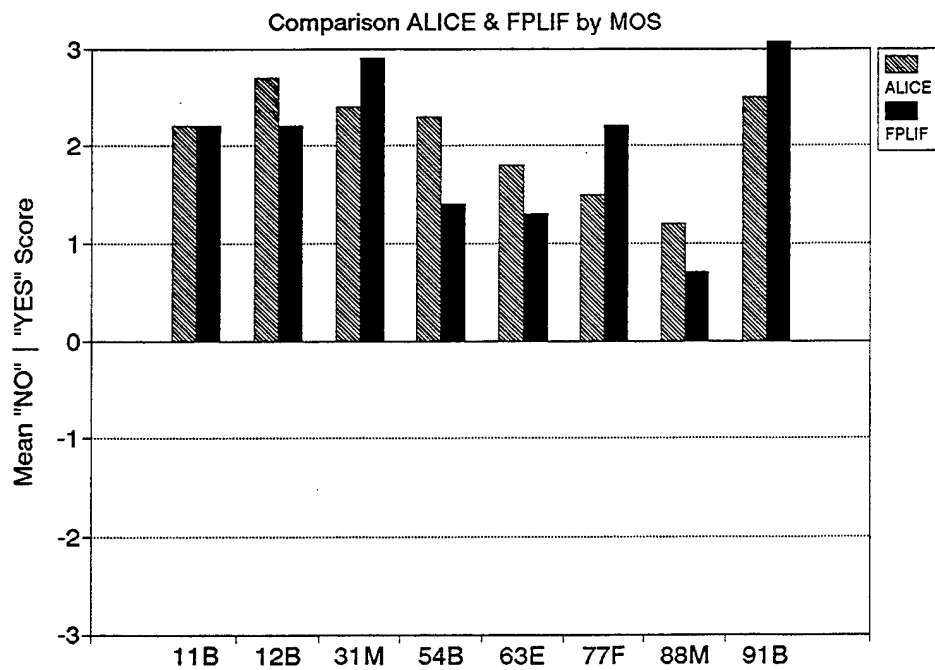


Figure 4. Is Assault Pack Good Idea?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

indicated agreement for both ALICE and FPLIF with the emphasis being greater for the FPLIF.

c. The Natick OFIG Surveys: The 10th Mountain Div (L), with experience using both ALICE and FPLIF and participating in the Jungle Operational Training in Panama, was surveyed in 1990 and asked which frame system they preferred. Seventy-eight percent (of 151) said they preferred ALICE. In 1993 the 7th Infantry was surveyed after a California desert National Training Center (NTC) exercise wherein 56% (N=36) preferred ALICE, 32% preferred FPLIF, and 32% had no preference.

d. User Feedback from USAIS Survey of Units with Defective FPLIF: Six of the nine units opted for BOTH types of packs while three selected the ALICE-only option (see the discussion of previous issue above).

e. Comments: By asking soldiers their preference between these two packs right after warm weather missions the surveyors should have expected a bias in favor of the system that is better designed for warm weather conditions. The FPLIF would more likely get higher ratings after being used during cold weather operations since it was originally designed for that environment.

#### **4. SHOULD THE LBE BE A MODULAR SYSTEM?**

a. Muddy Boot Working Groups: Modular was defined as having components that can be moved, removed, and reconfigured for different users and missions. Pockets and pouches could be rearranged, special pouches or carriers could be attached for unique equipment. The first group concluded it should be partially modular with some features fixed while Group 2 thought the system should be totally modular. However, the joint conclusion was that there were only minor differences in the two groups' definitions of modularity and that they were basically describing the same system.

b. The LBE Questionnaire Survey: The questionnaire did not ask this question directly but the last question asks for suggestions for improving load bearing equipment. A very high proportion of the comments included the desire to have a detachable assault/patrol pack (Figure 4) and many requests for a butt pack for ALICE (Figure 5) and several recommendations for detachable pockets. There were also recommendations for having special sized pockets for M60 ammo, night vision devices, and other difficult-to-carry items. This response begins to add up to a modular requirement.

c. Comments: The big issue with modularity is whether or not fasteners can provide the stability and durability of sewn on pouches and pockets. Modularity is also a problem for logistics and assuring that the right components are available when needed. Modular units require more National Stock Numbers



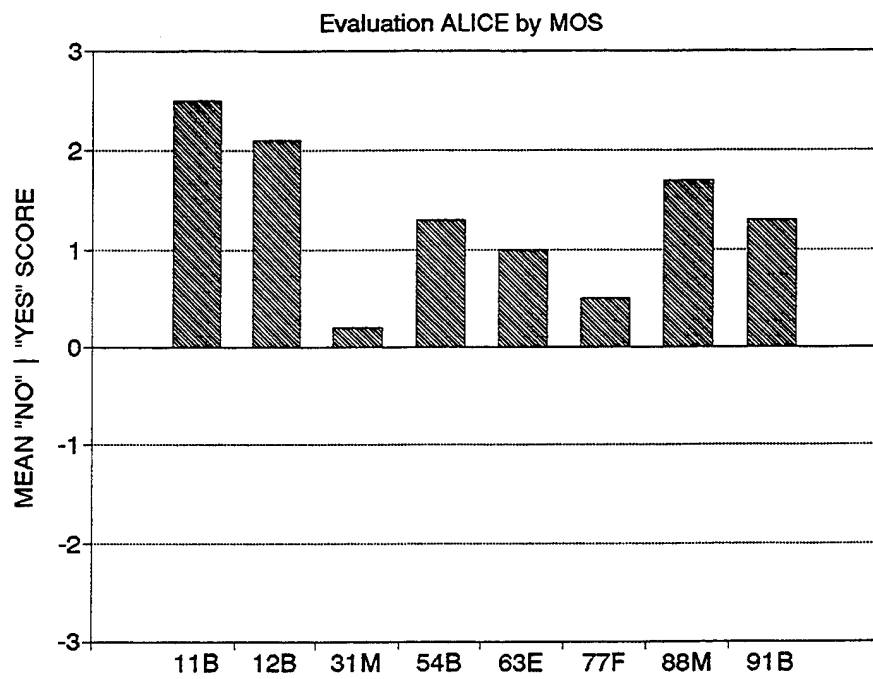


Figure 5. Does ALICE Need Butt Pack?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

and more storage area in depots. On the positive side, new designs, capabilities, or items can be accommodated without buying whole new pack systems.

#### **5. WHAT SHOULD BE THE MINIMUM CONFIGURATION?**

a. Muddy Boot Working Groups: Both groups agreed that the minimum should be a tactical load bearing vest system. The second group stated that the pockets should be removable on the vest when used under extremely warm conditions.

b. The LBE Questionnaire Survey: There were 1553 responses to the question: "What type of support system do you prefer to carry your fighting load - a. Web Belt & Suspenders or b: a fighting Vest which carries critical items on the front? (Or do you need both in the system?). Thirty-two percent selected alternative b: - the fighting vest, which carries critical items on the front. Twenty percent selected the Web Belt and Suspenders with 24% indicating that both systems were needed (Figure 6). Since the choice of the fighting vest alternative implies the choice of items carried on the front, it is not clear that the vest per se is clearly preferred over the lighter web belt and suspender system. Since the choice of "BOTH" implies that the minimal system (lightest) is the suspenders and belt then it could be said that 44% want the suspenders and belt as their minimal configuration. It may also suggest that 66% want a front loading system.

c. Comments: A vest system as the minimum LBE poses a potential problem when considering heat stress. The most commonly seen LBE in photographs of soldiers in the field is the suspenders and web belt. In warm conditions suspenders and belt are likely to be the preferred light fighting load configuration, since a vest system has greater potential for heat build up. Developers should anticipate that soldiers, in the future, are likely to express dissatisfaction if the system no longer has the simpler web gear available.

#### **6. WHAT PART OF THE SYSTEM SHOULD BE ADJUSTABLE (FIT VS LOAD ADJUSTMENTS)?**

a. Muddy Boot Working Groups: The working teams agreed that frame adjustability was preferred over different sizes of frame because of situations where soldiers must exchange equipment. As long as durability and simplicity were not compromised, the adjustability was favored. However, it was stated that if the target population includes both male and females, then alternate frame sizes and adjustability may both be required.

b. The LBE Questionnaire Survey: The responses of the eight MOS groups all had mean positive agreement scores above 2 (any mean above 1 indicates strong agreement, see Figure 7) to the statement that adjustability was a good idea for

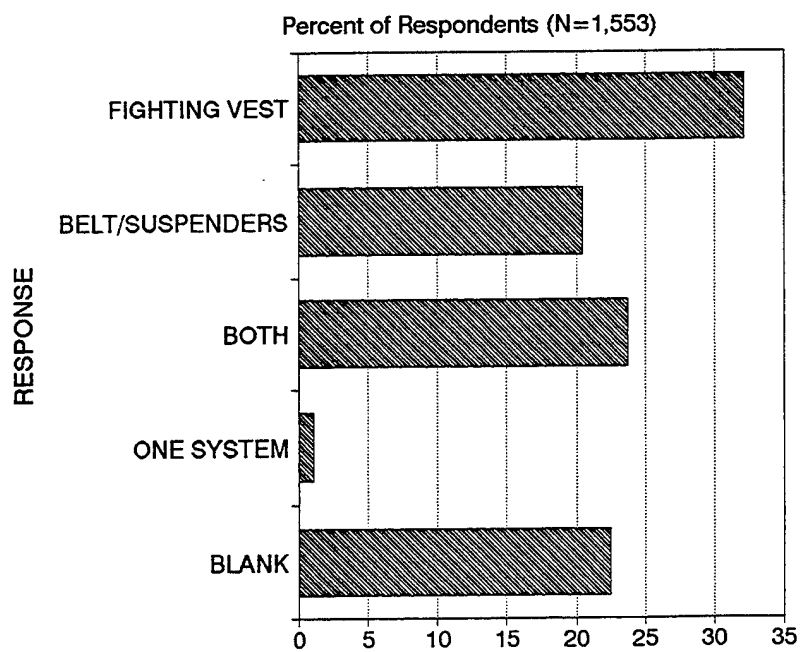


Figure 6. Prefer What Suspense System?

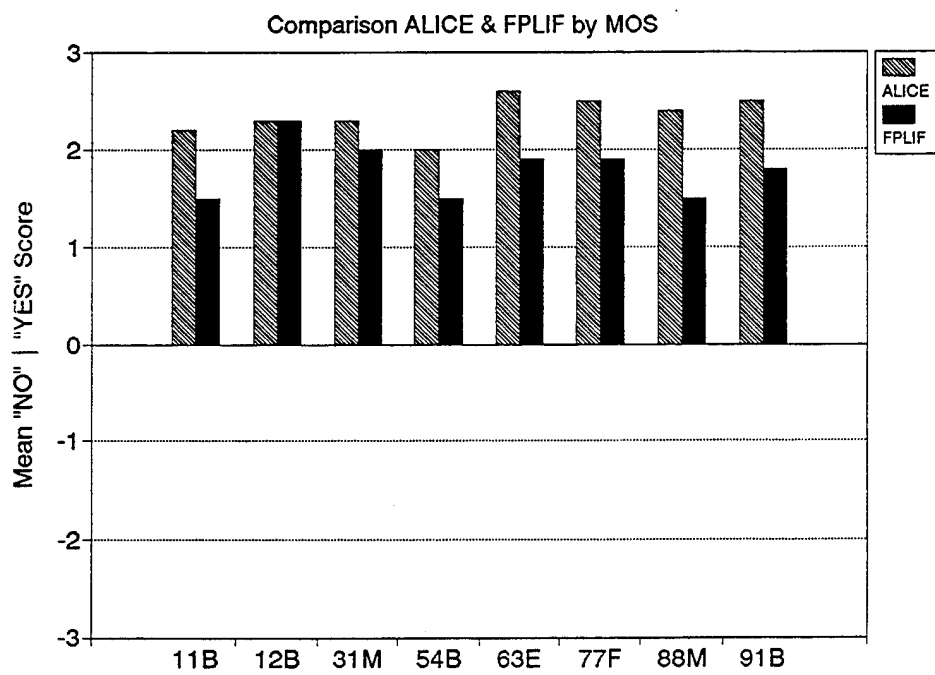


Figure 7. Adjustability Good Idea?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

the ALICE and the FPLIF systems. All MOS groups strongly agreed that different sized frames were needed for the ALICE system (Figure 8). The responses to the question about whether there are too many straps indicate little or no concern about the ALICE in this respect but a slight concern for the FPLIF (Figure 9). In general, responses indicate a strong need for adjustability or sizing for fit. When comparing male vs. female responses, it was found that adjustability was number one and need for sizes number five for the females (see Figure 10). For males the strength of agreement for adjustability was 7th and for sizes 9th out of 32 statements (Figure 11).

c. Comments: Although having a selection of sizes as well as the ability to adjust the frame to each individual's physical dimensions would help make load carriage more efficient and reduce discomfort, both adjustability of the frame and having multiple frame sizes pose certain problems. An adjustable frame may increase weight and cost in order to be durable. Multiple sizes create a logistic burden and increase the likelihood of even poorer fit when individuals of the extreme small or large size get the opposite large or small frame. (Mismatched are a real possibility considering the manner in which sized items are typically distributed to troops.)

## **7. VOLUMES AND DIMENSIONS: WHAT SHOULD THE CAPACITIES BE?**

a. Muddy Boot Working Group: Both teams agreed that the volume capacity of the main pack should be approximately that of the ALICE large. Group 2 introduced an optional butt pack that would represent added capacity. Both groups suggested an assault pack that provides additional capacity over the ALICE large.

b. The LBE Questionnaire Survey: Among the eight MOS groups represented in the analysis, all indicated the ALICE large to be too small (Figure 12). In addition, all MOS groups "disagreed" with the statement that the ALICE was too large (Figure 13). The female personnel responses indicated that ALICE medium is too small for their uses (their 8th ranked statement, Figure 10). However, a special surveillance unit's topped ranked statement for the ALICE was that it was too small; they strongly disagreed that it was too large (Figure 14). They strongly disagreed that the FPLIF was too large (Figure 15). For their mission with bulky camera equipment there seems to be a requirement for a larger pack. This may be true for other soldiers and marines who have certain bulky equipment like the DRAGON, VIPER or M60 MG weapons. The responses on the FPLIF indicate users like the sizes and number of outer pockets. Many stated that the ALICE should have similar type pockets. Sizing the main pack and the assault pack such as to better accommodate the SINCGARS radio was frequently mentioned on questionnaires.

Sizes of outside pouches may be determined by what soldiers/marines say they would like to put into them (Figure 16). When asked which items are put in the outer pouches,

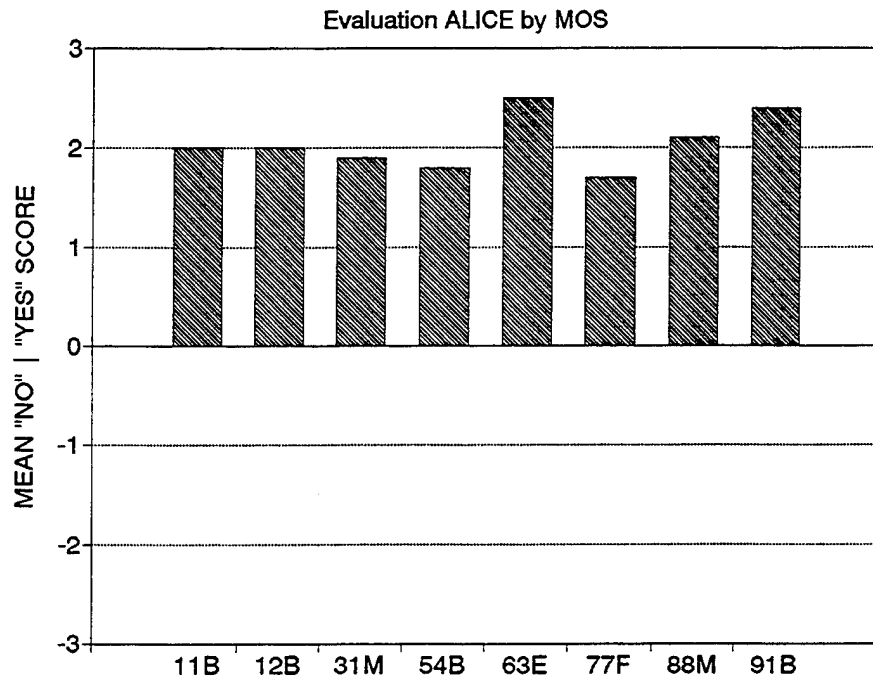


Figure 8. ALICE Needs Sizes of Frames?

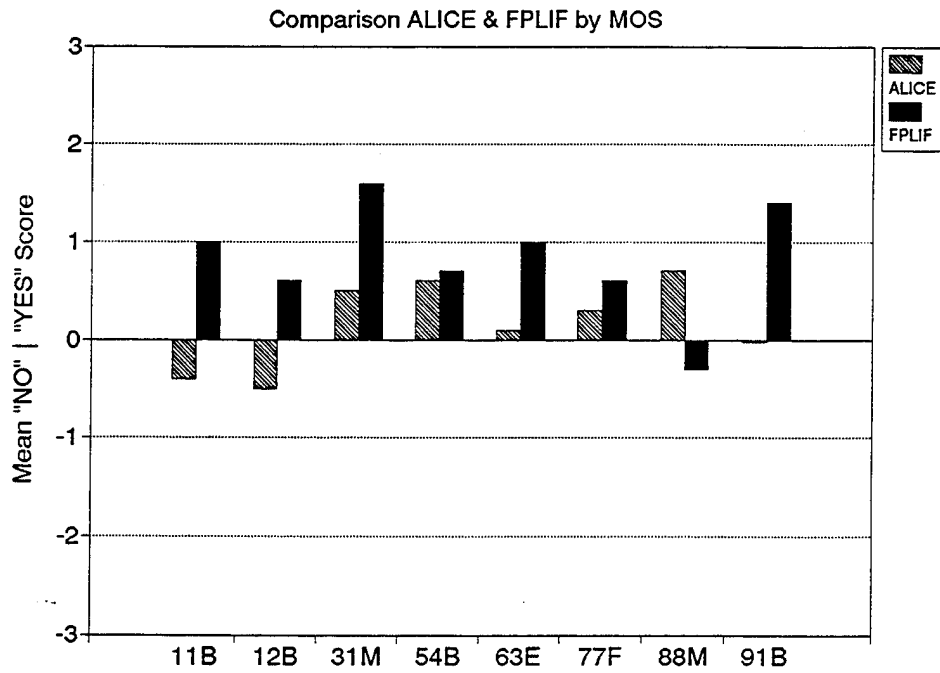
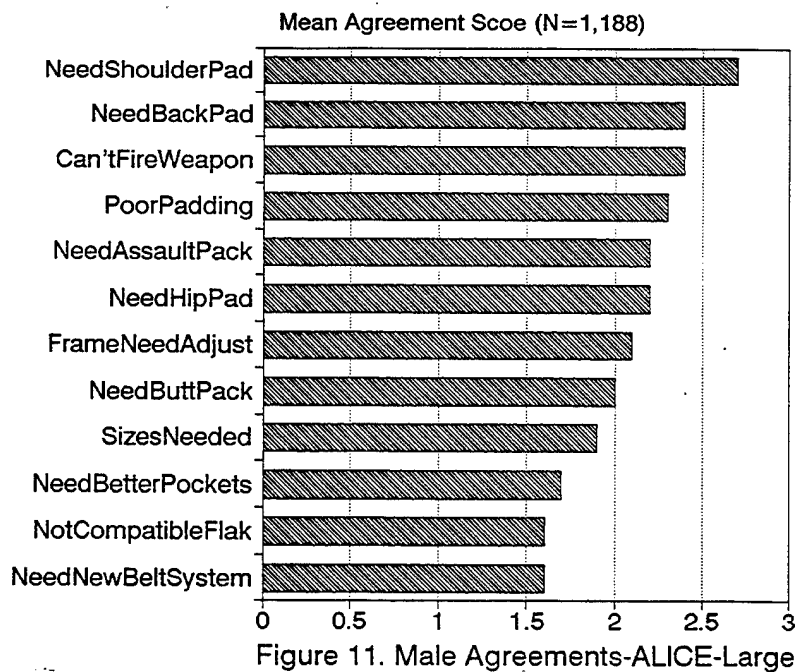
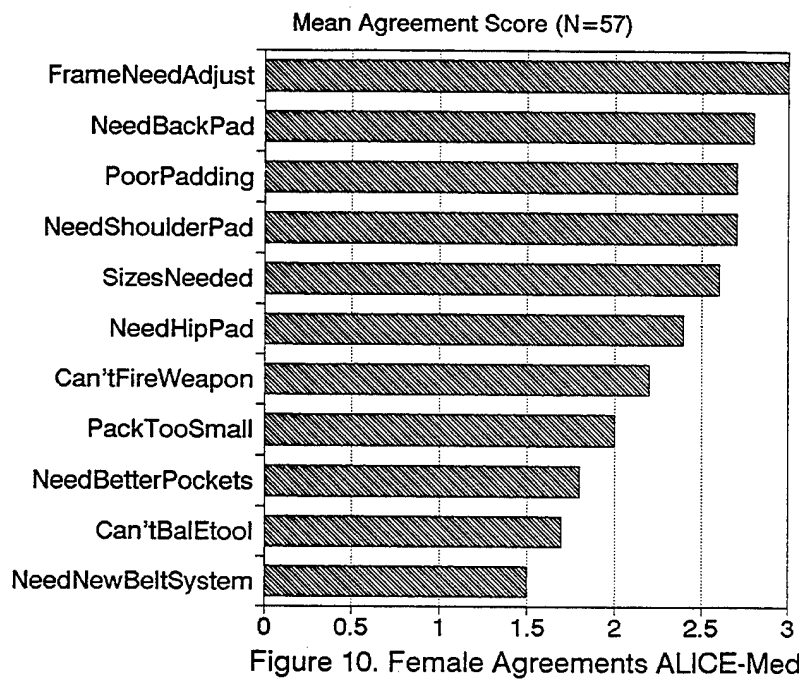


Figure 9. Pack Have Too Many Straps?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic



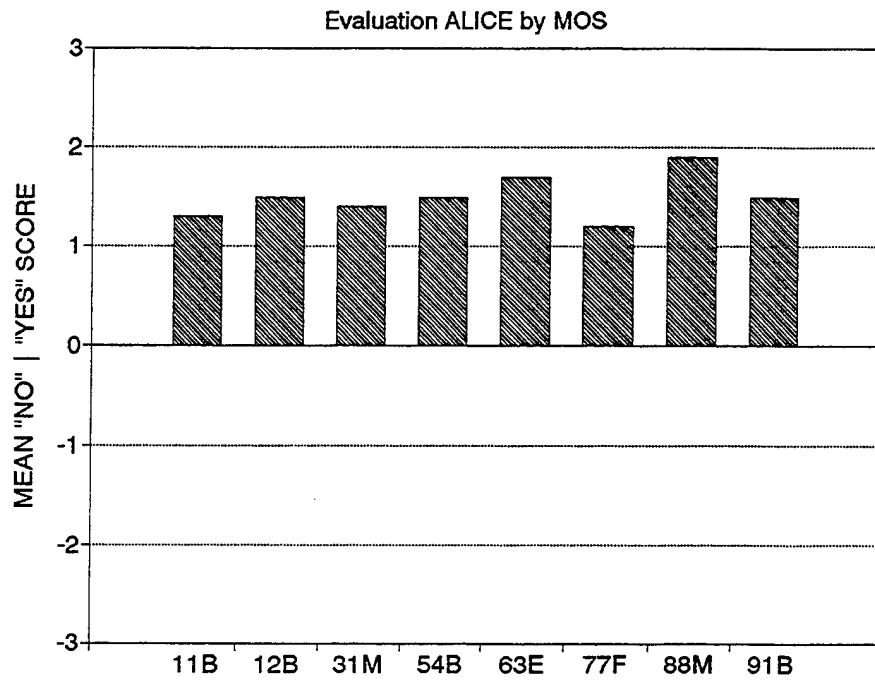


Figure 12. Is ALICE Pack Too Small?

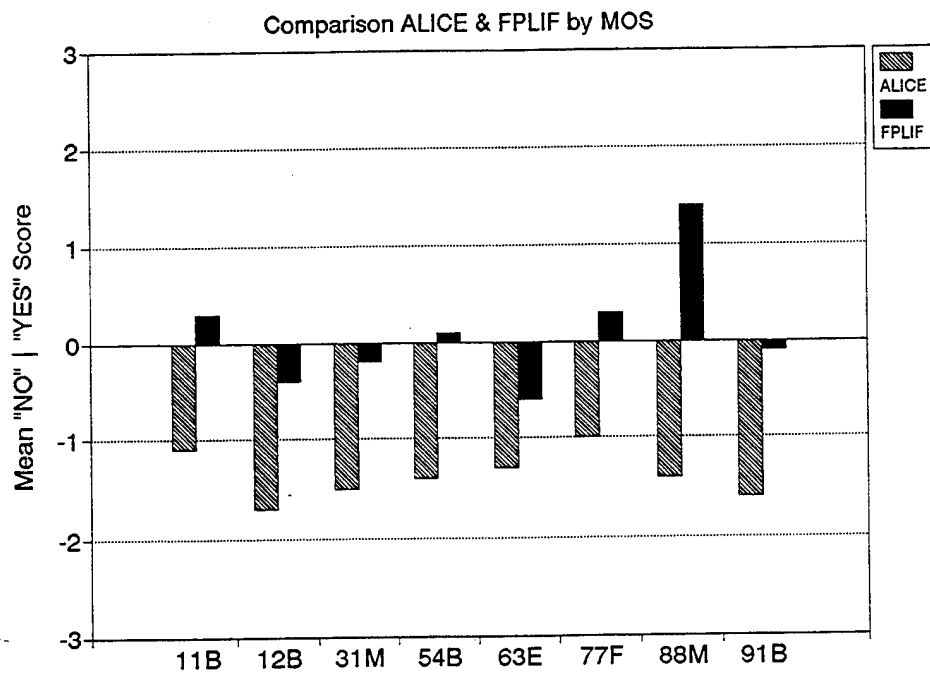


Figure 13. Do Packs Have Too Much Room?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

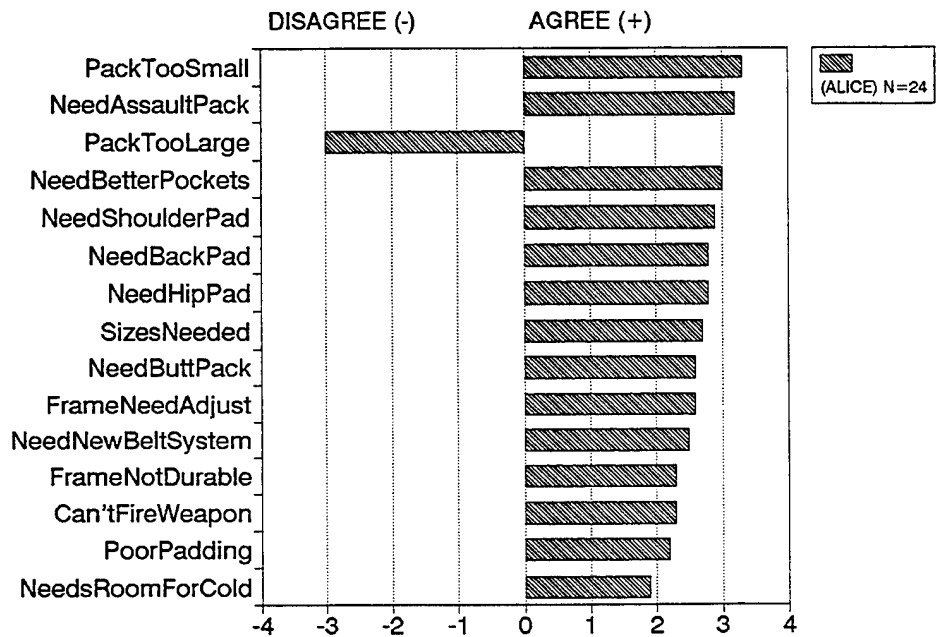


Figure 14. Special Ops Top Statements - ALICE

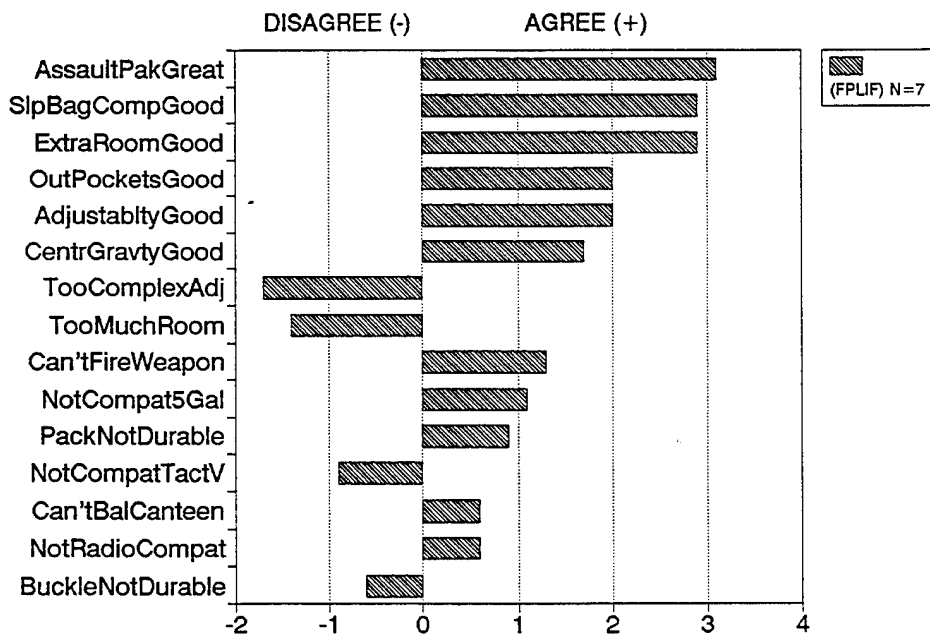
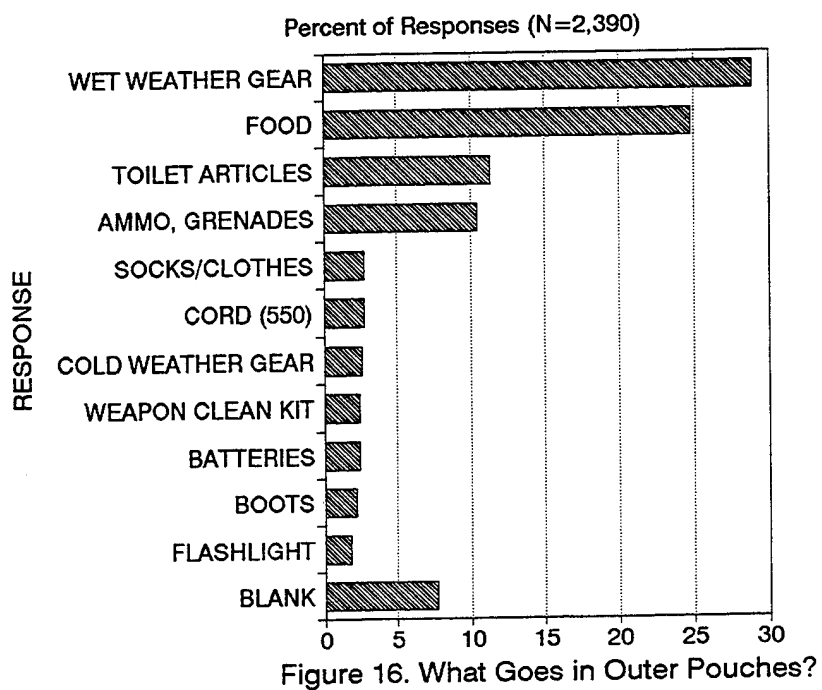


Figure 15. Special Ops Top Statements - FPLIF





wet weather rain gear or poncho represented 29% of the items, food 25%, hygiene, shaving and toilet articles 11%, ammo 10%, socks and other clothes 3%, 550 cord 3%, weapon or weapon cleaning kit/oil 2%, batteries 2%, boots 2%, and flashlight 2%.

The last question asks for suggestions to improve the load bearing system. The most frequent recommendations were more and larger outside pouches on the main ruck. Many argued that outside pouches allow ready access to many different items without having to wade through all the stuff in the main pack. The number of respondents who said "larger and more outside pouches" was so large that it clearly indicates these are highly needed features of the ALICE pack. Many asked for pouches that would accommodate M60 ammo, night vision goggles, and other bulky items. The unit radio was also frequently mentioned as an item needing a larger compartment. More pouches were also called for on the assault pack. There were also several statements that special operations requires more room than is provided by the ALICE-large pack. As mentioned above, a special surveillance unit complained that the ALICE large was too small for their equipment.

c. Comments: As an initial guide to the optimal sizes of packs, pouches and pockets, the results of the surveys suggest that for most users it would be the pack size of the ALICE large or slightly larger and the number and sizes of the outside pouches of the FPLIF. A modular system could easily accommodate different sizes of outer pouches for attaching or removing the components most needed by a user. The modular system also allows for future changes by allowing new outer pouches sized for new equipment such as computers and power packs.

## **8. ARE THERE REQUIREMENTS FOR OTHER THAN TOP-LOADING PACKS?**

a. Muddy Boot Working Groups: Both groups recommended access to the main pack by a lower opening in addition to the top flap. The first group was concerned about the durability of zippers and recommended other type closures. Group 2 recommended cinching straps to support middle or bottom zippers.

b. From the LBE Questionnaire Survey: The suggestions for many outside pouches indicate a need for ready access to many different items. There were also many written-in suggestions for side or bottom access openings.

c. Comments: None.

## **9. WHAT ARE THE REQUIREMENTS FOR THE SUPPORT SYSTEM?**

a. Muddy Boot Working Groups: Group 1 recommended sternum straps and stabilizers as well as padding of the shoulder, back and hip supports. Group 2 recognized the problem of too many straps but also the importance of stabilizing the

load. Both teams recognized the need to eliminate conflicting belts, straps, etc. However, breathing was also mentioned as a problem when straps in the chest area are too tight. In general, there was overall agreement that there was need for cinching and load stabilizing straps.

b. The LBE Questionnaire Survey: The statement that the straps and ties for ALICE were too complex was not strongly agreed or disagreed with (Figure 9). However, the same statement for the FPLIF was agreed with by most of MOS groups. Thus, strap features need to be somewhere between features of the ALICE and FPLIF. The statement "ALICE needs a better belt system" was strongly agreed with by all MOS groups as shown in Figure 17 (see also discussion of belt system below). Stability was addressed in the statement "Pack is stable under heavy loads." and the responses by MOS indicate that stability is a real problem with the internal frame (FPLIF) but not so with the external frame (ALICE) (Figure 18).

c. Past Surveys: Respondents to the Natick OFIG surveys frequently reported problems with the various straps and the lack of support cross and cinching straps of the ALICE. Individuals involved in Operation Just Cause (Panama) in 1989, for example, complained of shoulder straps slipping off as well as durability problems with buckles and fasteners.

d. Comments: Making all the components of the load bearing systems compatible in terms of belts, straps and ties will be one of the more challenging design problems. Add the potential complications of padding and ballistic vests and the task is made even more difficult. It may take major technical program thrusts to solve some of these problems.

## **10. WHAT ARE THE REQUIREMENTS FOR QUICK RELEASE?**

a. Muddy Boot Working Groups: Joint agreement existed for rapid, single point release of the main load. Also the need for easy don and doffing should be considered as part of this issue. Including body armor as part of this requirement was recognized as a difficult technical challenge but important.

b. The LBE Questionnaire Survey: The statement "Can't drop quickly" was mildly agreed with for both ALICE and FPLIF (Figure 19). In the section asking for suggestions for improving the pack system, many stated the need for a more reliable and effective quick release.

c. Comments: Some users say that the release of the main load needs to be instantaneous. That is, faster than quick. Past efforts have found that quick releases often become unpredictable releases. Instantaneous release is a challenge to design. There have been some debates about whether or not a single release needs to also have a left-hand option. However, there is no evidence that the release mechanism needs to be on

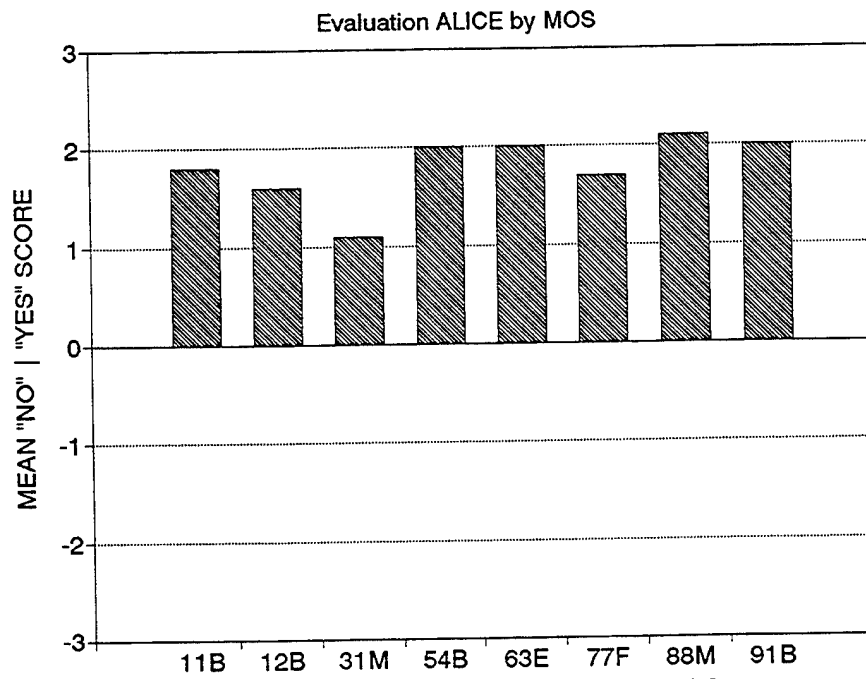


Figure 17. ALICE Needs Better Belt?

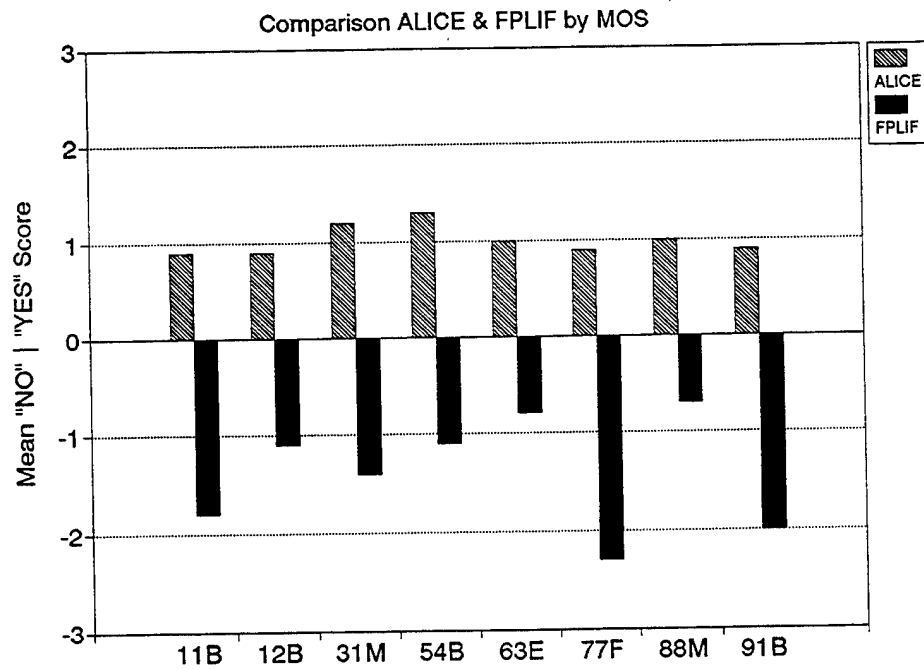
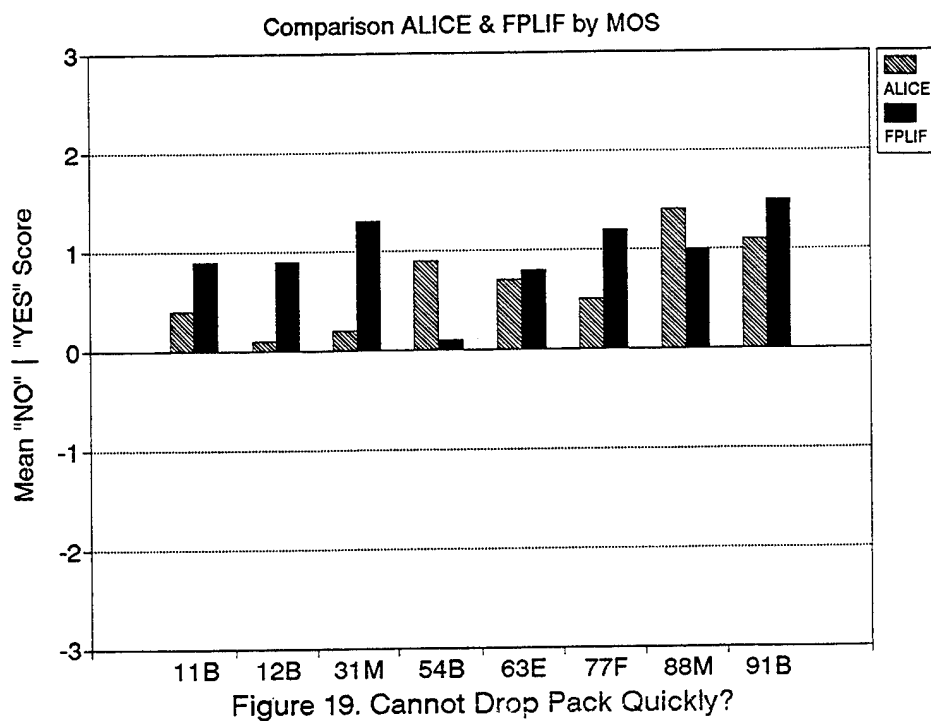


Figure 18. Is Pack Stable with Load?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic



11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
 77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

the side of one's dominant hand. It's a simple pull procedure, not a fine dexterity operation.

#### **11. IS THERE A REQUIREMENT FOR THE ABILITY TO FIRE WEAPON PRONE WITH FULL LOAD?**

a. Muddy Boot Working Groups: Group 1 reported that there was a problem with being able to fire one's weapon with a full load and while in the prone position. Group 2 acknowledged the need to fire the weapon while prone but they also stated that the requirement was more general than that. There is a need to be able to move one's head in a way that allows looking up and at angles whether one is prone or not.

b. The LBE Questionnaire Survey: For both the ALICE and the FPLIF the statement that one can't fire one's weapon while prone with a full pack was among the top four statements with strong agreement. The agreement is strong for all MOS groups for both types of packs (Figure 20). This was true for nearly every grouping of the data, including both the female/male summaries (Figures 10 & 11).

c. Comments: There are design concepts, such as the Israeli curved top frame, that attempt to address the problem of bumping one's head or helmet on the top bar of the external frame. This and other concepts need to be explored.

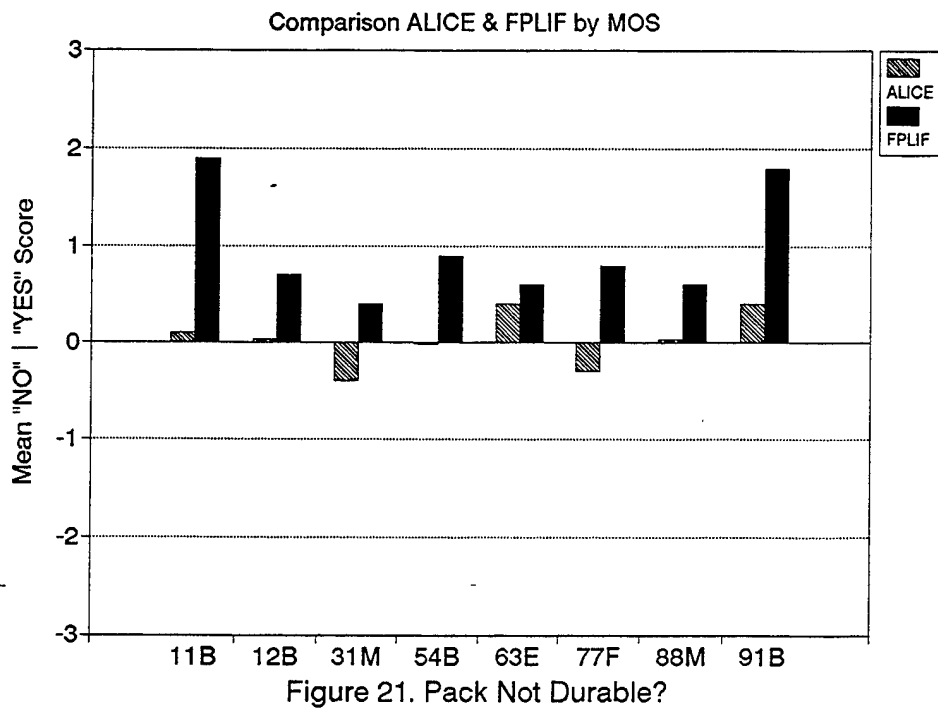
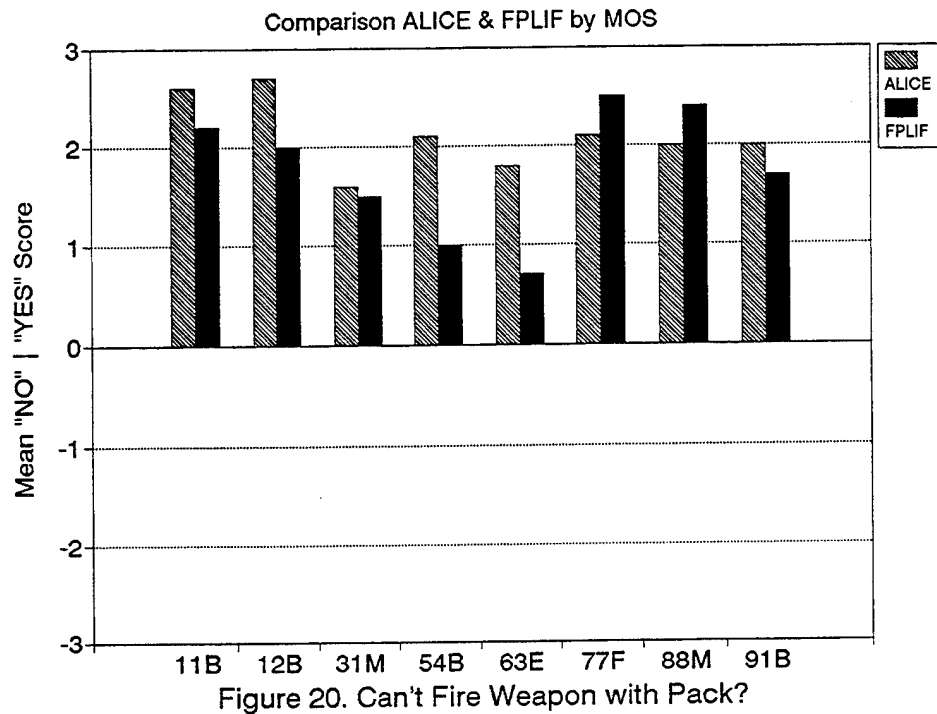
#### **12. WHAT SHOULD BE THE REQUIREMENT FOR SYSTEM STRENGTH AND DURABILITY?**

a. Muddy Boot Working Groups: Both groups concluded that the load bearing systems should undergo stringent tests where they are drop tested with at least 120 pounds. There are too many deployment situations, like airborne operations, where heavy items are thrown into or on the load bearing equipment. The frame and pack must withstand rough treatment with heavy loads.

b. The LBE Questionnaire Survey: Analysis by MOS shows that pack durability is not a problem for ALICE but is for FPLIF (Figure 21). Individual comments at the end of the questionnaire indicate there are durability problems with the ALICE frame. Respondents also indicated ALICE has had a number of problems with durability of buckles and fasteners.

c. USAIS Survey of FPLIF: One of the respondents to this survey was emphatic that a load drop test be required with minimum of 120 lb. If the pack and frame are designed to pass this test, there would be fewer failures related to tearing, ripping and deformation during combat deployments.

d. Past Surveys: Soldiers returning from Operation Just Cause (Panama) complained of many durability problems which



11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

included breaking of straps, tearing of seams, and deformation or breaking of the external (ALICE) frame.

e. Comments: To date, there has been no durability drop test requirements for load bearing equipment. Given the real world of the military operations, there is a need to design to stringent drop strength and durability test requirements for the equipment itself.

### **13. WHAT ARE THE REQUIREMENTS FOR FIELD CLEANING (LAUNDERING) AND REPAIR?**

a. Muddy Boot Working Groups: None of the participants saw a need for field laundering. "You just kick off the dirt." Laundering in garrison, however, is an issue. The troops are likely to machine wash even though laundering shortens the life of the system and diminishes the effectiveness of the surface treatments and camouflage print. Requirements for appearance in garrison are sometimes more important to users and their leadership than what is required for reasonable treatment of their equipment in the field.

b. The LBE Questionnaire Survey: The question about laundering was not included in the survey.

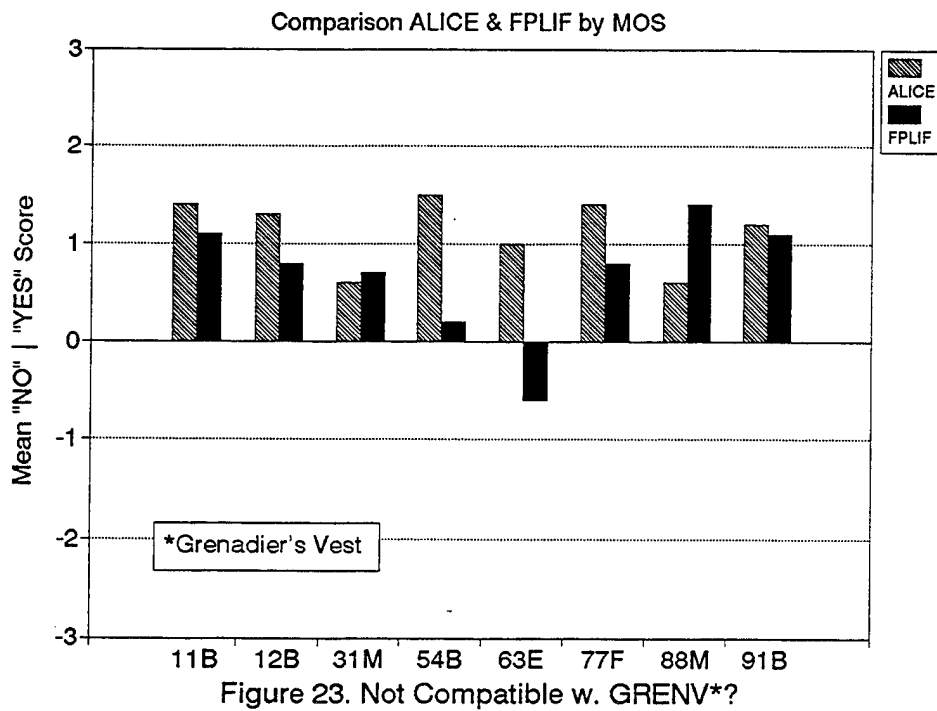
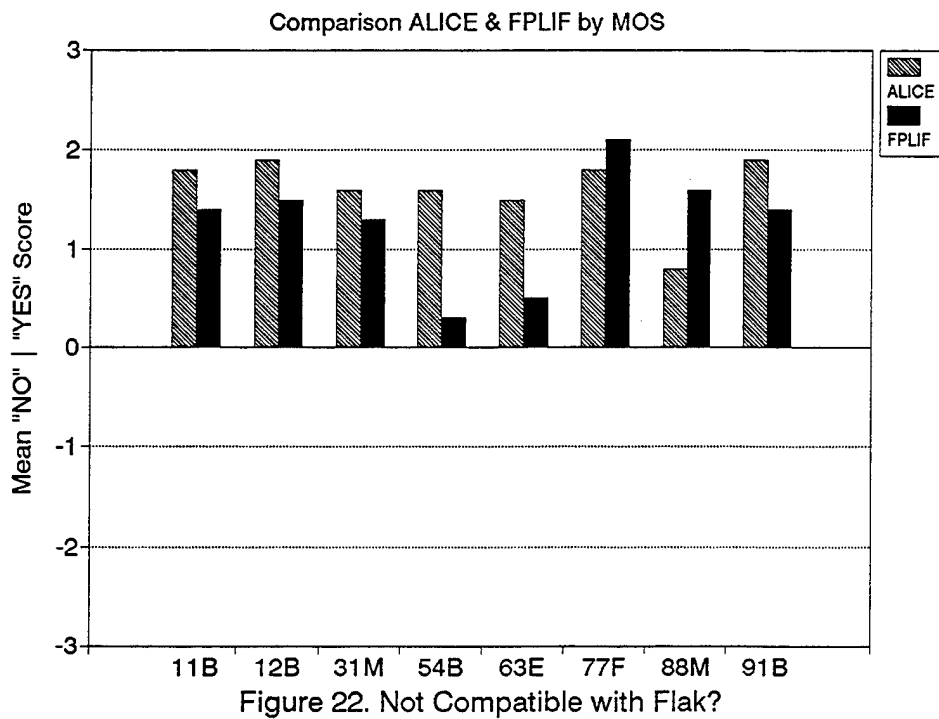
c. Comments: Current fabrics used in load carrying equipment cannot be laundered in a washing machine. However, soldiers insist on throwing all equipment in the laundry to be ready for inspection after a Field Training Exercise (FTX). This severely deteriorates the equipment. This area could benefit from further consideration, e.g., the development of fabrics that can withstand repeated launderings.

### **14. WHAT ARE THE MAJOR COMPATIBILITY PROBLEMS WITH OTHER EQUIPMENT?**

a. Muddy Boot Working Groups: Both groups did list items that were incompatible but did not prioritize. No one saw the need for a side opening LBE for compatibility with a side opening ballistic vest. It didn't make sense to them. The problem of placing the rifle on the shoulder is an issue. There may be ways to help hold the weapon on the shoulder. New adjustable rifle stocks may also help. There was some discussion about the difficulty of getting in and out of hatches and openings of vehicles with the LBE.

b. The LBE Questionnaire Survey: The statement that the ALICE is not compatible with the Flak jacket (body armor) was strongly agreed with by all MOS groups (Figure 22). The same is true for the FPLIF except for the 54B (Chemical Specialist) and 63E (Abrams Mechanic) MOS who were relatively neutral on the issue. Similar, but less consistent, agreement was found regarding the compatibility of the Grenadier's Vest (Figure 23). Lack of compatibility was also reported for the Medic's Bag, with





11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

the Medics 91B showing the strongest response (Figure 24). Figure 25 suggests there is reasonable compatibility of the Unit Radio (SINCGARS) with the ALICE but there is a serious problem with the internal frame's (FPLIF) compatibility with the radio. This negative sentiment is strongest among the communications specialist (31M). All MOS groups also report that the FPLIF is incompatible with carrying the 5 gal container (Figure 26). ALICE appears to have a compatibility problem with the new Tactical Load Bearing Vest (TLBV) (Figure 27). Since the FPLIF and TLBV were developed as a system, it is not surprising that the mean scores indicate they are not seriously incompatible. Other compatibility problems were also reported and are shown in the figures.

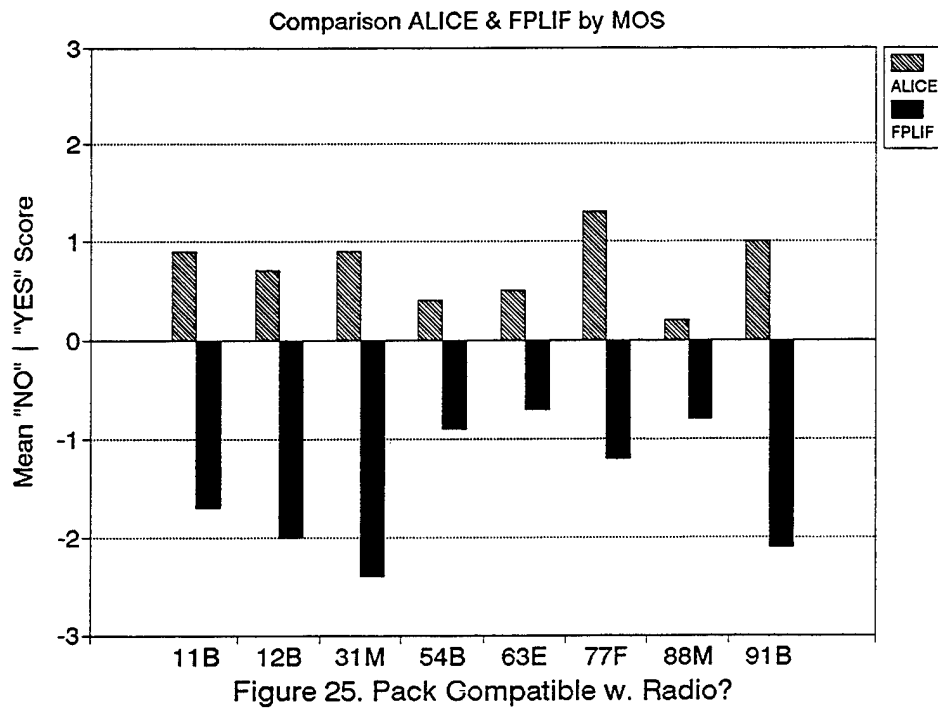
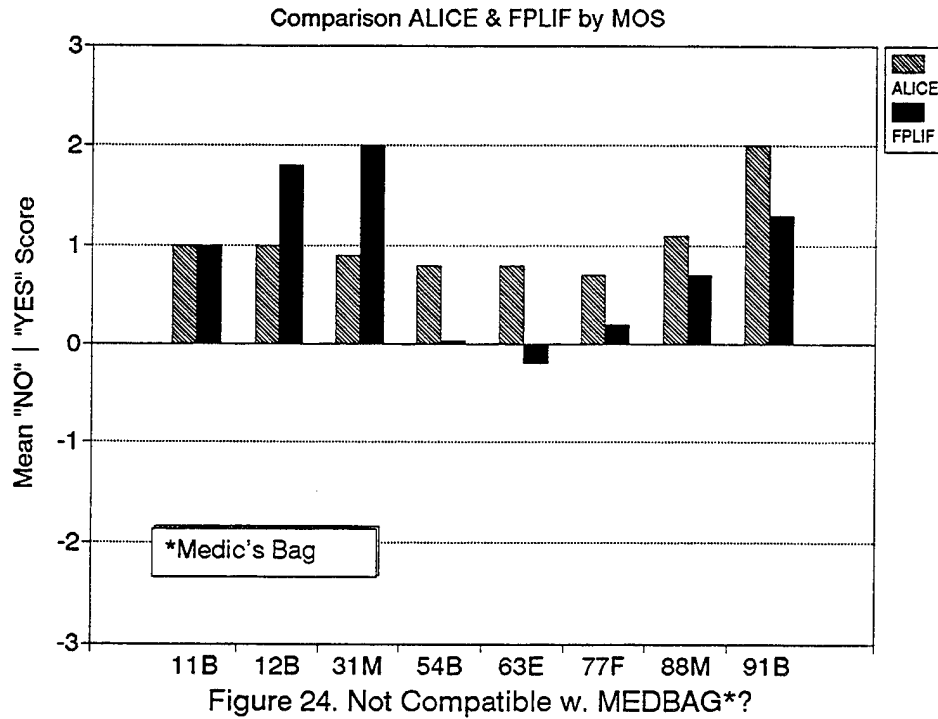
Results of the open-ended questions on the questionnaire were answered as follows. When asked about problems wearing the Flak Vest with the load bearing equipment, only 11% of those who responded (N=1,152) said No Problem (Figure 28). Seventeen percent said the vest was too hot, 14% said it was too bulky, 9% said it was too heavy, 8% said it was difficult to adjust, 8% said it was uncomfortable or it hurt, 7% said it didn't fit or they couldn't buckle the belt, and the remainder said it was difficult to don/doff, they couldn't fire weapon prone, or they thought the Flak Vest useless.

c. Comments: A careful review of missions is likely to find that requirements for body armor and full load bearing do not frequently overlap. Consideration should be given to designing a minimal body armor that is highly compatible with a full load (fighting and sustainment equipment) for initial deployments and a body armor module that can carry basic fighting equipment without the LBE system for special police actions.

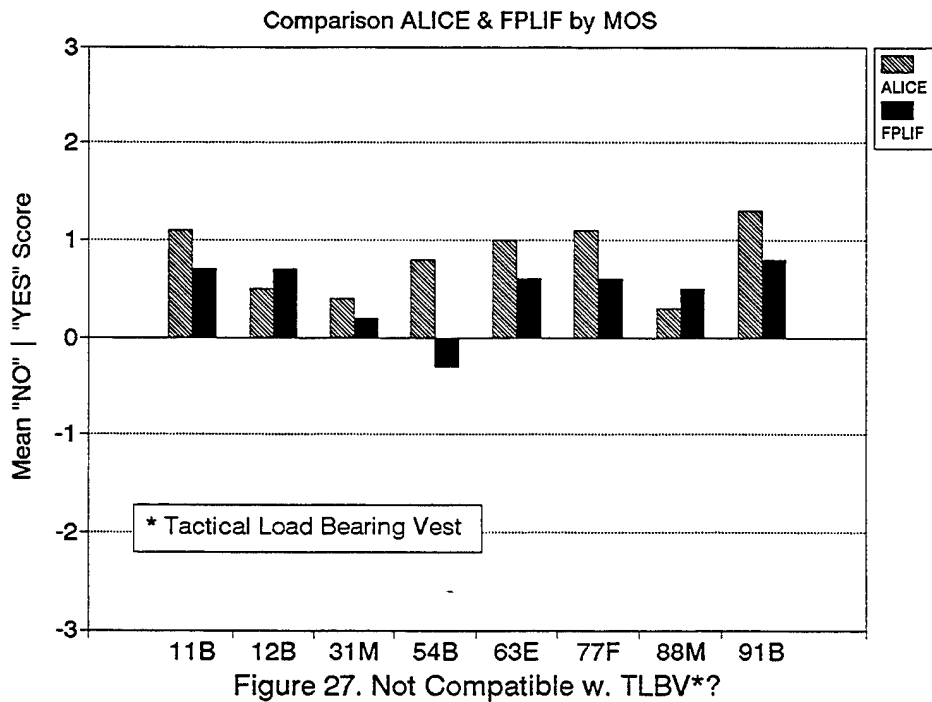
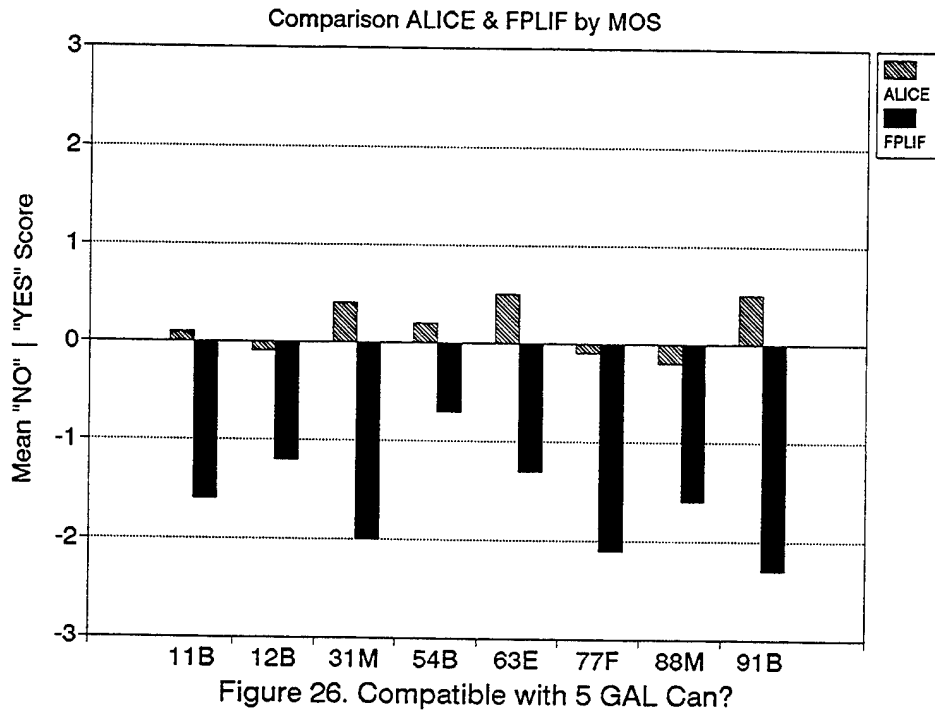
## **15. HOW MUCH PADDING SHOULD BE REQUIRED?**

a. Muddy Boot Working Groups: There was concurrence about the need for more padding but there was also a concern about heat stress and bulkiness. There is a problem, however, with too many layers when you add the ballistic vest. There was the suggestion that wider straps may compensate for thicker padding. Although there was a call for more padding, no one knew the impact of extra padding on the overall system.

b. The LBE Questionnaire Survey: One of the strongest responses on the questionnaire involved the need for more padding. All eight MOS groups strongly agreed with the statements that the padding was poor on ALICE (Figure 29). There was a need expressed for more padding on the shoulders, hip and back. For nearly every grouping the need for more shoulder padding had strong agreement.



11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic



11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

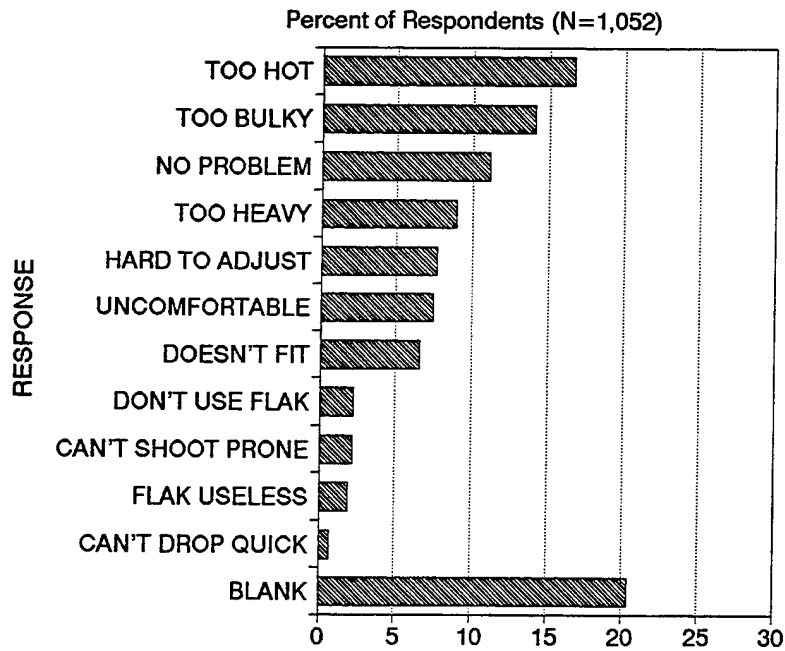


Figure 28. Problems Wearing Flak & LBE?

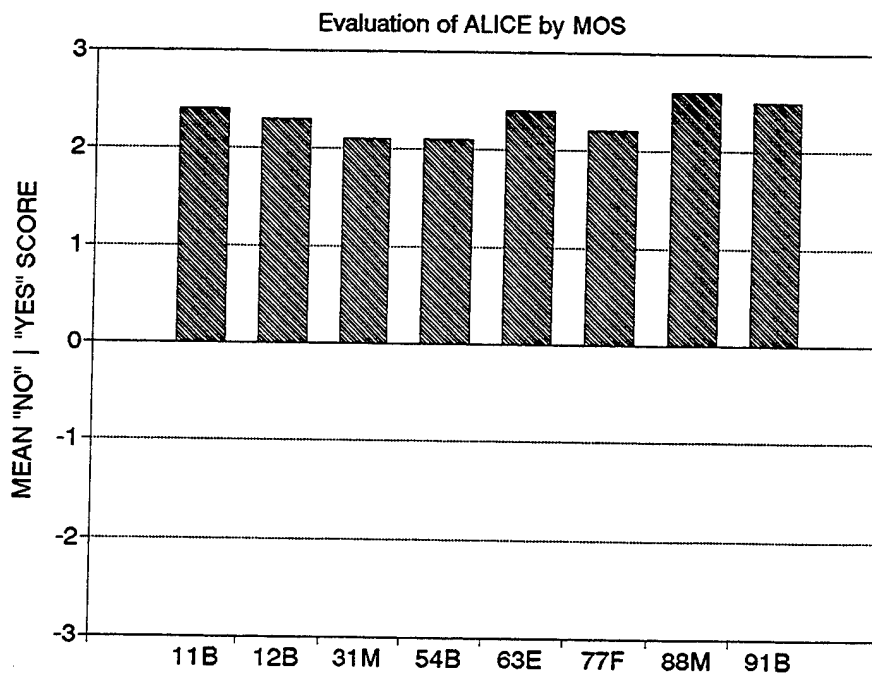


Figure 29. ALICE Padding Inadequate?

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans. Spec; 91B Medic

c. Past Surveys: One of the more common complaints in the OFIG surveys has been the discomfort of the load on the shoulders and the need for padding. This was true, for example, of the 92nd Military Police in Panama in a 1993 exercise.

d. Comments: The most common complaints are about lack of padding. However, the main problem is simply soldiers tend to carry too much equipment. Estimates of the weight of the typical deployment loads ranged from 80 lbs to more than 150 lbs, exceeding recommended load limits based on human factors guidelines. Furthermore, the tendency not to use the hip belt adds strain to the shoulders. Increase in padding may help but, unless better practices of distributing the load are implemented and the magnitude of the loads carried reduced, more padding will not likely do much to solve the problem. This is an area requiring special training.

#### **16. WHAT ARE THE REQUIREMENTS FOR FASTENERS, CINCHING STRAPS, LOOPS, RINGS, AND HOOK-LOOP FASTNERS (VELCRO (tm))?**

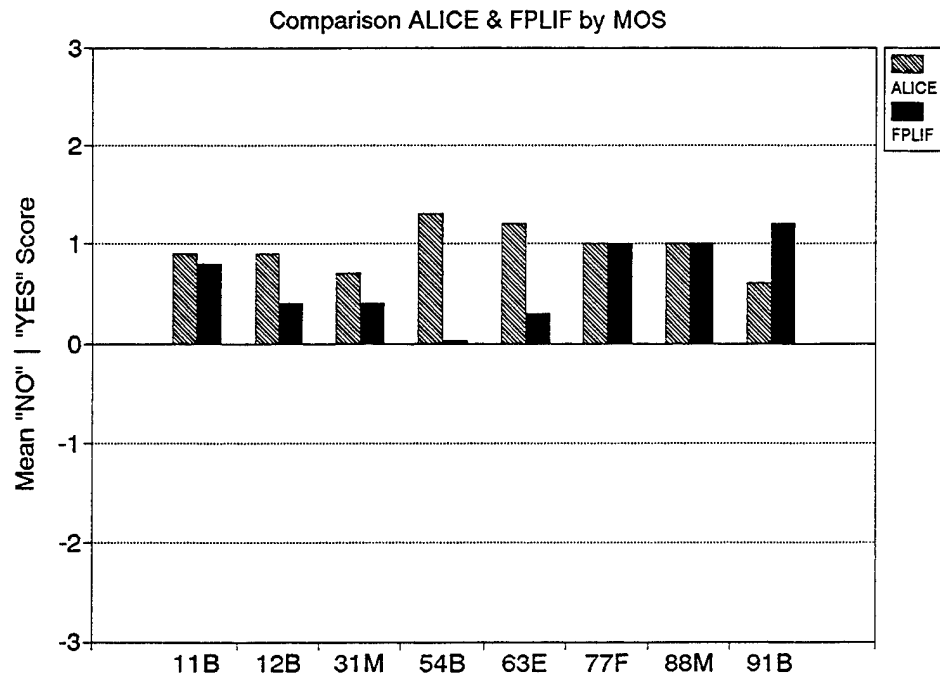
a. Muddy Boot Working Groups: There was concern about hook-loop fasteners being noisy and getting dirty. One group suggested that these fasteners be designed so they can be replaced. Other types of fasteners are available that are easy to use, quiet, and durable. However, certain plastic snaps on the front of their equipment tend to break and they are not easy to repair. Cinching straps and loops are needed to tie on wire cutters, strobe lights, flashlights, compass, and other items.

b. The LBE Questionnaire Survey: See discussion of durability above. In the section on recommending improvements there were many suggestions for tie-down straps inside the main pack to help secure items. Stability is an important feature of load carrying and tie-downs and cinching straps help keep the load stable. When asked if ALICE and FPLIF are stable under heavy loads respondents indicated that ALICE is stable while the FPLIF is not (Figure 18). The main problem with an internal frame system is the loss of stability with very heavy and bulky loads. There is some indication also that items like the canteen are problems because of stability and balance (Figure 30).

c. Comments: Cinching things down and making the load stable is a key factor for reducing the physical burden (energy cost) of carrying equipment on the outside as well as the inside of the pack. Canteens, e-tool, and other items are frequently reported as problems because they bounce around too much.

#### **17. WHAT ARE THE REQUIREMENTS FOR WATER REPELLENCY AND WATERPROOFING?**

a. Muddy Boot Working Groups: Based on the discussion in this session there appears to be a common misunderstanding of the terms waterproofing and water repellency. It was suggested that the term "rain proofing" be used to describe water



**Figure 30. Cannot Balance Canteen?**

11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

repellency and "immersion proofing" for waterproofing, which means to go through water without getting gear wet. Immersion proofing would require waterproof bags. Rain proofing involves treatment to the material to help repel rain. Both groups stated there is a requirement for both.

b. The LBE Questionnaire Survey: A very large number of respondents wrote comments on the questionnaire about making the pack "waterproof". Some said it should be built into the pack and pouches but most didn't specify how. It is suspected that many were actually concerned about water repellency but instead said waterproof.

c. Comments: While making the main pack rain resistant is feasible, waterproofing (immersion proofing) the whole pack and its pouches is not, nor is it practical. Waterproof inserts are currently available but the problem becomes having a good supply of such bags available. The counter-point to this is the request for drain holes in the pack and pouches. Current waterproof liners are not issued with the pack and many soldiers don't know they exist. A new field pack should be issued with liners as part of the item.

#### **18. WHAT ARE THE REQUIREMENTS FOR CAMOUFLAGE, INFRARED DETECTION, NOISE REDUCTION?**

a. Muddy Boot Working Groups: There was some discussion about the potential of the color gray for camouflage. The final recommendation, however, was that the standard camouflage be the same as the Battle Dress Uniform (BDU) (currently the woodland pattern). Covers could provide alternative camouflage for different environments, such as deserts or the arctic.

b. The LBE Questionnaire Survey: The questionnaire did not address the issue of camouflage.

c. Comments: It might be helpful to consider camouflage and IR under the general concept of stealth which would also include noise reduction. Stealth, in all its aspects, is a major concern of the user.

#### **19. WHAT ARE THE REQUIREMENTS FOR A BELT SYSTEM?**

a. Muddy Boot Working Groups: The subgroups were in agreement about the need for improvement of the ALICE belt system. Multiple belts are a major problem. Adding to the complication is the call for additional padding when carrying heavy loads. The joint group called for eliminating multiple belts and providing a belt that can be quickly adjusted to changing layers of protection and, at the same time, accommodate padding when needed. Soldiers (and Marines) may need training on the value of a hip belt for distributing heavy loads.



b. The LBE Questionnaire Survey: Based on the question "Does the Army Need a New Belt System" all 8 MOS groups included a new belt system in their top 15 agreed-on statements (N=1,280) (Figure 31). The magnitude of their responses is shown in Figure 17. Several of the answers to other questions tell us why. In response to the question as to whether the pouches on the equipment belt tend to get in the way of the waist belt [of the frame] 60% of the respondents (N=1,844) said Yes (Figure 32). To the the question "Do you keep your hip belt open?" sixty-three percent (N=1,844) said Yes (Figure 33). The most frequently reported reason for leaving the hip belt open was for comfort (46%, N= 935), 10% said it was too restrictive, 8% said must detach quickly, 7% said it digs into hip, 6% felt it was useless, 2% said it was hard to adjust and 2% said it didn't fit (Figure 34).

c. Comments: Developing an effective, easy-to-use belt system will be one of the greater technical challenges of a complete modular load bearing system.

## **20. ARE THERE REQUIREMENTS TO ACCOMMODATE MEDICAL INTRAVENOUS (IV) BAGS AND STARTER KITS FOR EACH SOLDIER AS PART OF FIGHTING LOAD?**

a. Muddy Boot Working Groups: There was a brief discussion on this issue in Group 2. Comments were that this is becoming a frequent practice. The group thought an outside pouch (protective) should be specially designed for this and it needs to be designed to go with the fighting load.

b. The LBE Questionnaire Survey: This question was not included in the questionnaire survey.

c. Comments: There now seems to be a requirement for soldiers to carry a medical IV bag and starter kit as part of the combat load. Thus, there should be a requirement for the pack system to accommodate this item.

## **21. OTHER ISSUES AND ANALYSES**

a. Integration vs Separate Systems. Out of 1,480 respondents who were given the question "Should the flak vest and load bearing equipment be one system or kept separate?" 45% said it should remain separate, 23% said one system and 32% left it blank (Figure 35). Of the 1,411 who were given the question "Should body armor have pockets/pouches to carry items for the fighting load?" 70% said Yes, 22% No, and 8% left it blank (Figure 36). These results suggest many want to keep the items separate but at the same time they want the body armor to have some load carrying capabilities.

b. Heat Stress. The issue of heat stress has been discussed above in a number of places but it is worth a summary review. The mean responses to the question "Is the Pack

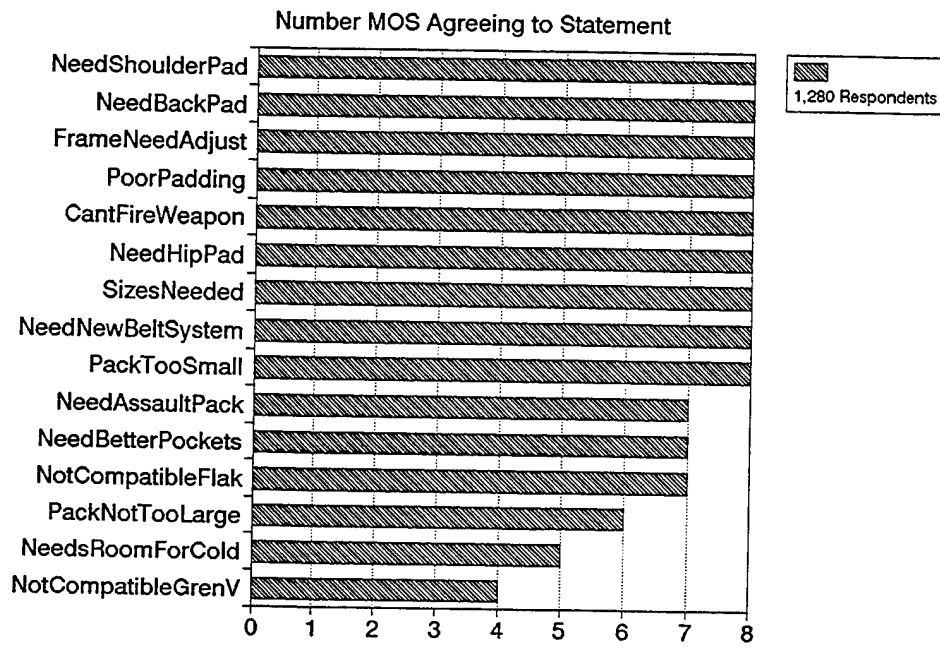


Figure 31. Top Statements of Eight MOS

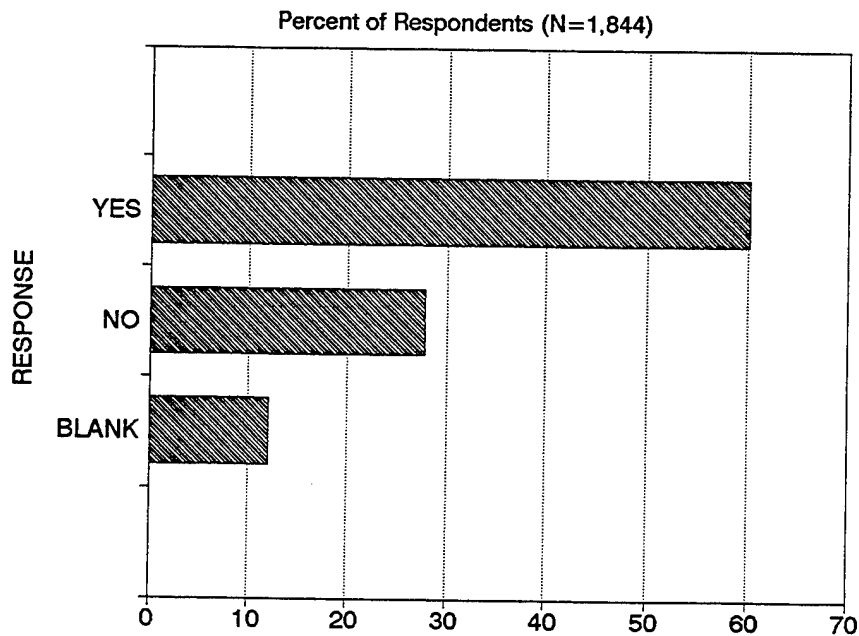
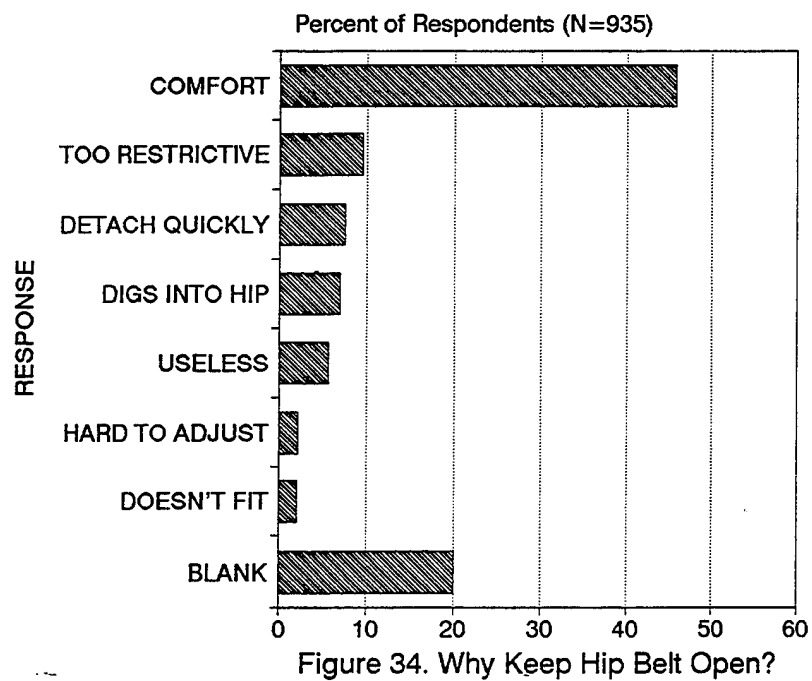
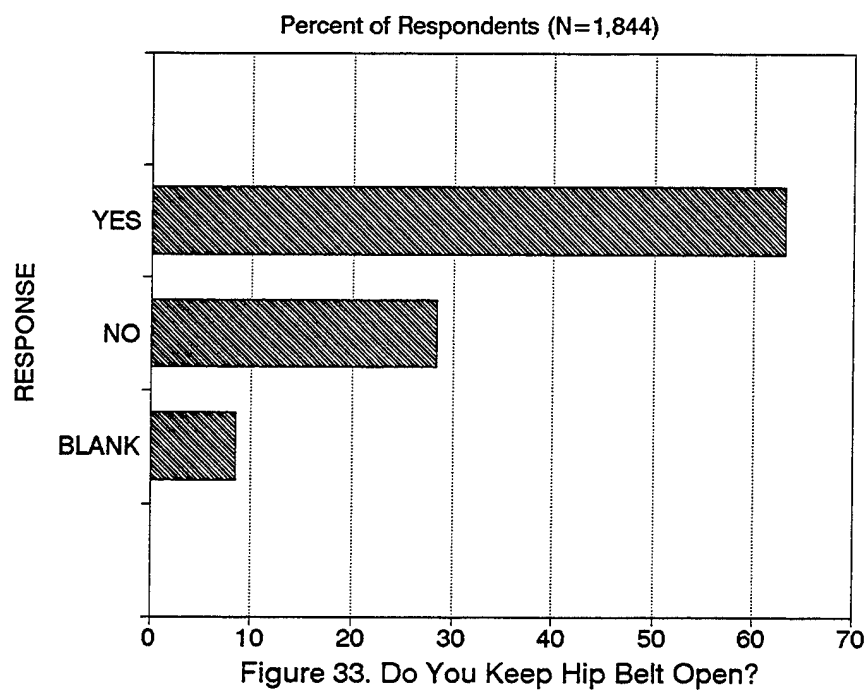
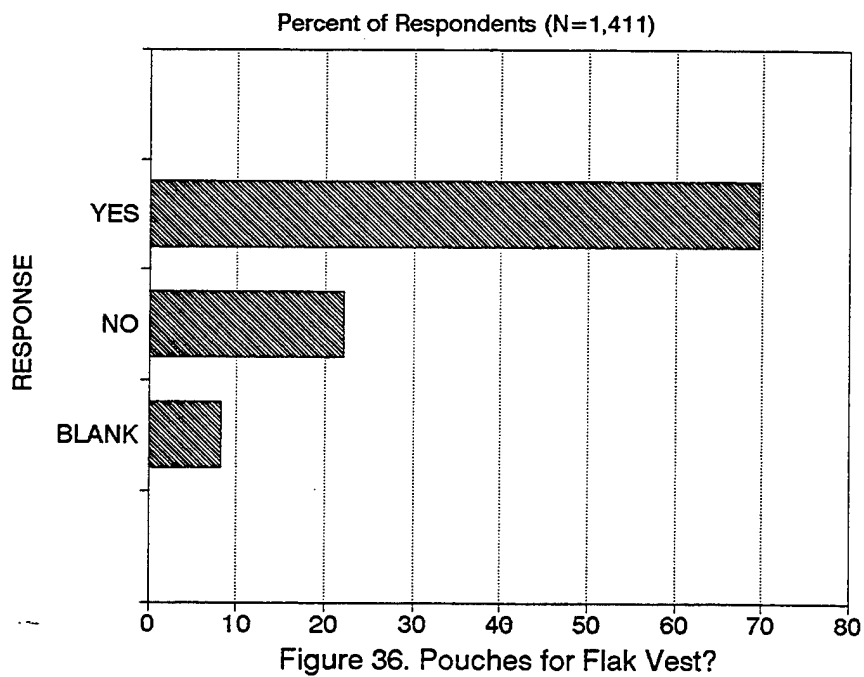
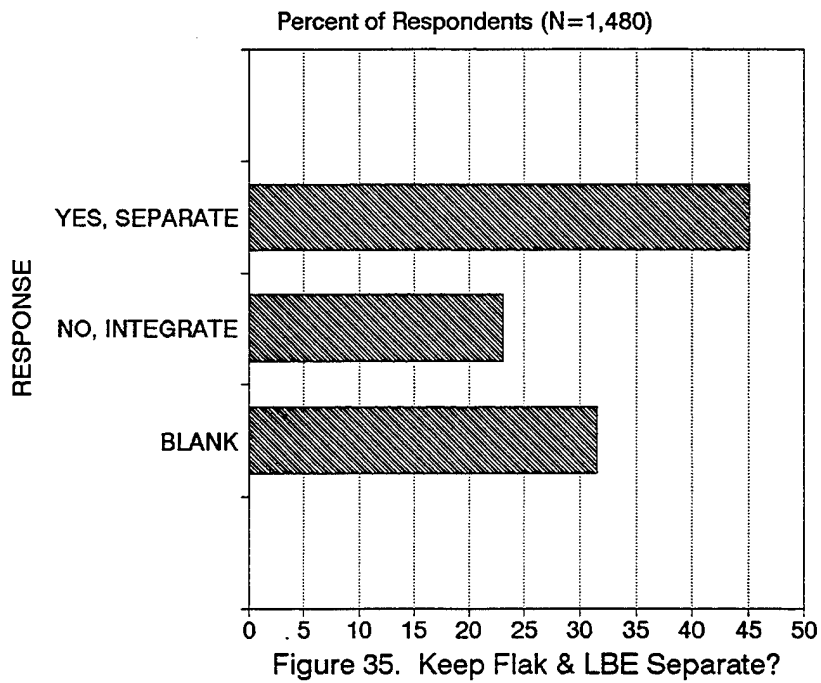


Figure 32. Are Pouches In Way of Pack?

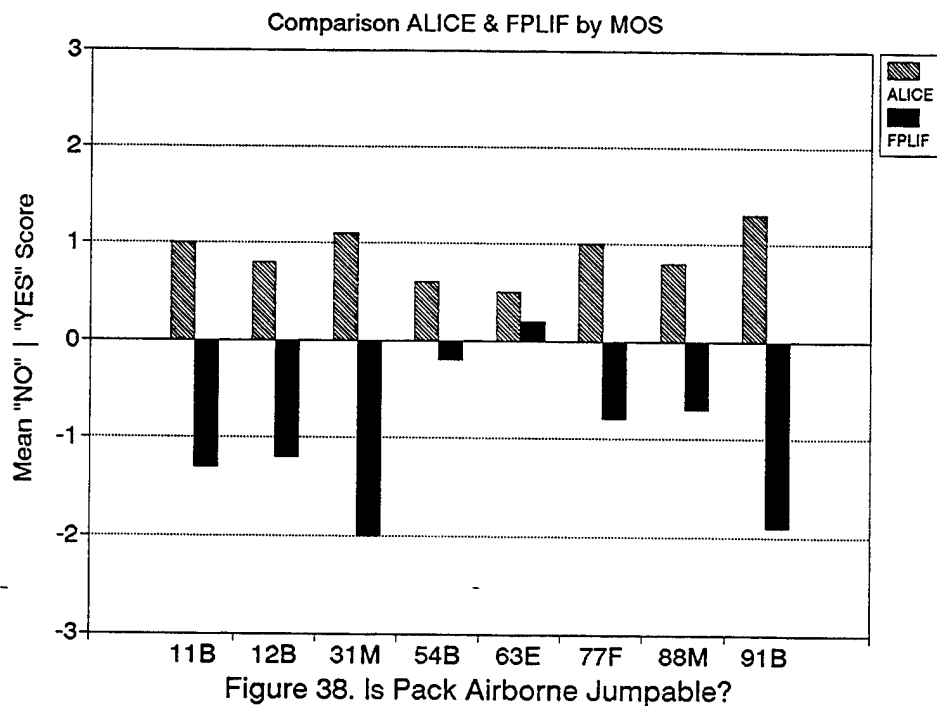
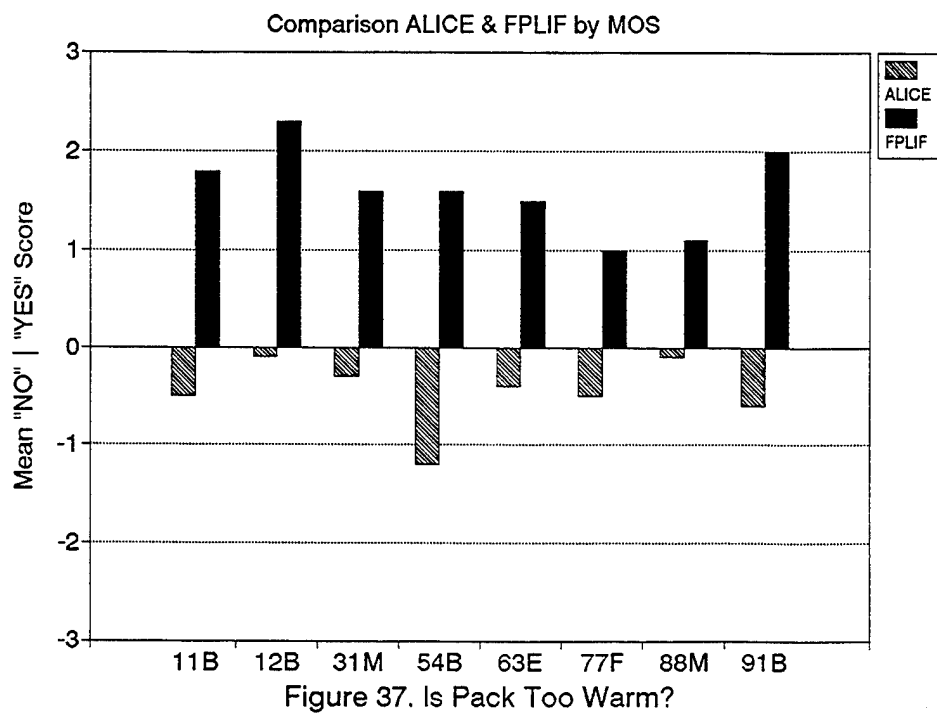




Too Warm?". All MOS groups agree that the FPLIF has a problem in warm climates while ALICE does not seem to have the problem to any significant degree. Figure 37 shows the contrast between ALICE and FPLIF in terms of heat build up. The concern with the FPLIF as being too warm in warm climates is well known. It really needs to be identified as part of the extended cold weather system as originally conceived. The external frame (ALICE) offers a stand-off to help vent heat. However, the call for more padding for the load bearing system will likely result in future complaints of the system as "too warm". Options need to be considered. As the results above show, heat stress is also a problem with the flak jacket worn with the load bearing equipment and the two may be judged as incompatible. Selecting the tactical vest as the minimum fighting load system may result in future complaints since the user may note that vest is not as cool as the "old web gear" (suspenders and belt). However, the active work of soldiering in warm climates will always be hot work even with a minimal amount of clothing and thus there is a limit to what can be done with these systems without the aid of mechanical cooling.

c. Airborne Compatibility. Strong concerns were reported in the responses to the USAIS survey that the FPLIF was a serious problem for parachutists. Indications of this were also found in this FEA survey. Figure 38 shows the response to this question for both ALICE and the FPLIF by MOS. Except for the responses by the Chemical Specialists (54B) and the Abrams Mechanics (63E), there seems to be agreement that there is a problem for the FPLIF. The responses were particularly strong for the Communications Specialists (31M) and the Medic (91B), which probably corresponds with their special load requirements.

d. Future Requirements. Based on work done on the Soldier Integrated Protective Ensemble (SIPE) Advanced Technology Demonstration (ATD), the challenge of the future will be to accommodate the electronics of the soldier system in the pack system in addition to the traditional load. The future soldier is expected to have a computer, a head-mounted display and other electronics. The associated hardware, wiring, and batteries will need to be compatible with the load bearing system. Where does the computer go? The batteries? How do you harness the wiring and how are all these things connected and how do you design it for quick release, fording rivers, and so on? SIPE technology and configurations required a sizable backpack for just the electronics and power. There was little room for much else. Hopefully, future electronics will be much smaller and require much less power. If not, the problems like those faced currently by the Radio Telephone Operator (RTO) will be the problems of every infantry soldier. At this point the assumption should be that the electronics of the future soldier will be accommodated, at minimum, by a pouch which is part of the load bearing system. Unless the power requirements and the



11B Infantry; 12B Com Eng; 31M Comm; 54B Chem Spec; 63E Abrams Mech;  
77F Pet Sup Spec; 88M Motor Trans Spec; 91B Medic

physical size and bulk of the electronics are significantly reduced, these electronic components are not likely to be a common element of the soldier system.

## CONCLUSIONS AND RECOMMENDATIONS

This FEA was initiated in order to help determine the equipment requirements for load carrying within the Army and Marine Corps. Information was collected from a market (product) survey of existing systems, past military user surveys of load bearing systems, a user survey designed for this FEA and the "Muddy Boot" working groups at Ft. Benning.

The results are presented by the key issues initially identified as relating to an integrated load bearing system. In the market survey it was found that many packs on the commercial market have some interesting and promising features for military use but that none is able to meet all the requirements of the military. Several foreign packs also have features liked by a number of individuals but none seems to meet all the requirements initially identified. A prototype being developed by the Army Research Laboratory offers important and promising features like reconfigurable but sturdy attachment modules but the total package is not yet ready at this point. The results of Natick's OFIG user surveys also provided much information about the limitations of current systems and the desires of many users for a better system. Those surveys found many durability problems and the need of extra padding for comfort. A major problem included the incompatibilities between load bearing equipment elements themselves like belts and straps and incompatibilities between ballistic protection and other equipment.

In the FEA survey a large number of users were asked about many features of the ALICE and FPLIF and whether they agreed with comments frequently made about them. The findings support the reported concerns about compatibility, fit, comfort, durability and utility of existing systems. The results suggest that the requirement for a "flexible, modular system" is real. The features and capacities of the packs and pouches are a mix between those found in the ALICE-large and the detachable pack, the size and number of pouches of the FPLIF system.

The Muddy Boot working groups also reviewed most of the issues under discussion and recommended a modular system. They also recommended keeping and improving the internal frame as a cold weather system. Durability was also recognized as critical and the recommendation was for more stringent strength-durability testing. In addition to a detachable assault pack, the working group recognized a need for a butt pack in the system for greater mission flexibility. The adjustability of the frame and having various sizes to accommodate different sizes of individuals was identified as a requirement of the system. All components of the system need to be compatible and compatible with other equipment worn and carried by the combatant.

The principal recommendations drawn from this FEA are embodied in the Draft Statement of Need (see Appendix B). Among the more challenging suggestions is to provide some kind of adjustability for the ruck frame or suspension system and padded waist belt that is compatible with other clothing and individual equipment. However, the padding requirement should be considered in the context of how the soldier will carry his or her load. If either tactics or inefficient load carrying practices prevent proper use of hip belts, for example, then optimal design involving padded pressure points may not be of benefit and only add to the heat stress potential. In terms of requirements for special load carrying equipment, data indicate that a separate system for extreme cold weather is desired by some users. The internal frame and large pack appear to facilitate load carrying in cold and snowy environments. For most users the capacity of the large ALICE pack seems about right and should be considered for the new modular system. And finally, the external frame seems to offer the needed stability and stand-off characteristics for heavy loads.



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APPENDIX A  
MARKET SURVEY OF LOAD BEARING EQUIPMENT SYSTEMS



## APPENDIX A

### MARKET SURVEY OF LOAD BEARING EQUIPMENT SYSTEMS

An announcement was placed in the Commerce Business Daily soliciting vendor literature on modular load bearing systems. A description of a three-compartment modular pack was used as a desired item. Several companies responded. However, the definition of modularity was interpreted quite differently throughout the industry. To most of the respondents, a detachable day pack, for example, defined modularity. Only two companies (Adventure Tech and JS Industries) had numerous detachable pockets. None of the responding companies had a pack with large detachable compartments other than day packs or butt packs.

In Table A-1, the four unconventional pack/ideas are items that came to Natick as commercial product offerings and are provided in the table for information only. The price of the JS Industries pack may be high since it is a one-of-a-kind prototype. However, the JS Industries Predator vest is available commercially and the price shown is the market item. The volume data in Table A-1 are those given in the manufacturers' specifications. The other features summarized in the table are measures taken by the authors or their opinions. All day packs and butt packs were considered to be detachable compartments.

Table A-2 presents the fighting load carrier concepts that were evaluated. Several of the systems use components of the current U.S. Army ALICE system. The Israeli designs provide minimal coverage of the torso region and therefore may minimize heat stress.

Table A-1: Load Bearing Equipment Market Survey Results

Manuf.	Model	Frame Type	COMMERCIAL ITEMS					Weight lb	Adst Height	Cost \$	Comments
			Capacity Cu In	# Compart	# Detach Compart	# Pockets	# Detach Pockets				
Coleman	XPD	Ext	4560	1		4	3	6.1	yes	120	plastic xylel frame
Adv Tech	SF Elite	Int		3		5	5	10.2	no		patrol pack, butt pack
Camptrails	Nightsong	Ext	3818	2		6		5.4	no	119	womens design
Camptrails	Teton	Ext	4045	1		4		6.0	no	129	
Camptrails	Aluetian	Ext		2		4		5.0			
Dana Dsgn	Asiral	Int	7000	3	1	2		7.1	no	369	anatomical alum frame
Dana Dsgn	Yellowstone	Int	5050	3	1	4		6.6	Partial	299	Int. packboard frame
Defrance	Trixtor	Int		2	1	4		7.2	yes	272	water bottle holders
Granite Gr	Exp Quelico	Double	6100	2				4.4	no	200	no frame support
Gregory	Robson	Int	5925	3	1			6.8	yes	192	detachable butt pack
Jansport	Nepali	Ext	6200	3	1	8	1	6.1		225	anatomical alum frame
JS Indus		Ext		2	1	5	5	10.8	no	1000	modified ALICE Large
Karrimor	Condor	Int	6200	1		3	2	6.7	yes	249	similar to British Army
Kelly	Radial Light	Ext	5050	2		4		6.1		240	womens design
Kelly	Wms Rad Lt	Ext	5050	2		4		5.9		239	womens design
Lowe	Contour IV	Int	6025	3	1			5.6	yes	225	
Lowe	Sirocco	Int	4380	3	1			5.4	yes	195	
Madden	SP-1	Int		2		3		3.6	yes		
MEI	Anna Purna I	Int	5600	3	1	2		6.3	yes	130	lexan packboard frame
MEI	Anna Purna II	Int	7100	3	1			6.8	yes	132	lexan packboard frame
MEI	Shasta I	Int	4200	3	1			6.0	yes	135	lexan packboard frame
MEI	Shasta II	Int	4500	3	1			6.4	yes	138	lexan packboard frame
MEI	Eiger I	Int	6100	3	1	2		7.0	yes	154	lexan packboard frame
MEI	Eiger II	Int	7600	3	1	2		7.6	yes	157	lexan packboard frame
MEI	Starlight II	Int	6300	3	1	3		5.8	yes	133	aluminum stave frame
Millet	Cobalt 80	Int		2	1			5.0	yes	170	
Modan	Explore	Int		3	1	2		8.0	yes	319	Auto Adjust. System
Norrone	Recon	Ext		1		3	2	9.0	yes		welded frame w/shelf
Northface		Int		2	1	2		7.4	yes		internal packboard frame
Vaude	Myken	Int		1		4	3	4.6	yes	185	vented against back
Vaude	Relax	Int		3		4		5.6	yes	247	
UNCONVENTIONAL COMMERCIAL PACKS/IDEAS											
Busecks	Adjust Pack	Ext									frame adjust to carry load directly above head
Laurence/	Perkins Pack	Ext									pack can quick release from frame w/single point
Kohlbrat	UT2000										pack board rescue liter
Bunz											backpack, cot, tent
Tripack		Ext						~10			
FOREIGN MILITARY PACKS											
Australian		Int		2					no		no waist belt
Israeli	Frame Only	Ext						4.4			welded frame w/shelf
Japanese		Int		2		1		5.8	yes		similar to a small FLPIF

Table A-2: Market Survey Results for Fighting Load Bearing Systems

Manufacturer	Model	Modular	Adjustable Sizing	Price \$	Comments
Arktis	1722-25	partial	partial		detachable chest rig, British company
Australian Army	suspenders	yes	yes		same design as current ALICE system
Blackhawk	31VX00	yes	yes		attachment hardware is slide keeper (ALICE clip)
Blackhawk	323100	yes	yes		attachment hardware is slide keeper (ALICE clip)
Harris		partial	partial	190	pocket on back incompatible with wearing ruck
JS Industries	Predator	yes	partial	500	unique pocket attachment, body armor can be integrated into the vest panels, very costly
Israeli Army		no	yes		evaluated four similar designs, all use wide suspenders over shoulders and wide padded belt area with pockets sewn on, minimal coverage of upper torso region



APPENDIX B

DRAFT STATEMENT OF NEED - CLOTHING AND INDIVIDUAL EQUIPMENT: -  
MODULAR LOAD SYSTEM (PART I)



## APPENDIX B

### DRAFT STATEMENT OF NEED - CLOTHING AND INDIVIDUAL EQUIPMENT: - MODULAR LOAD SYSTEM (PART I)

#### 1. TITLE.

- a. Modular Load System (MLS).
- b. Action Control Number: TBA.

#### 2. NEED.

a. Individual soldier/marine capabilities involve carrying mission-essential equipment that maximizes lethality, survivability, sustainability, and mobility during combat missions. The key to maximizing these capabilities is the flexibility of the load-bearing equipment to be quickly modified for different equipment configurations while maintaining ergonomically efficient weight distributions and compatibility with other individual soldier/marine equipment.

b. Current load-bearing equipment items lack many of the desired characteristics of an efficient load-bearing system for the variety of loads carried by soldiers/marines. For many configurations there is incompatibility with other equipment, preventing efficient load carriage. The system is often too large or too small, depending on the mission. The current system does not easily accommodate a variety of unique loads such as those carried by communications specialists, medics, members of mortar crews, antiarmor crews and others, and is not designed for rapid reconfigurations in the face of changes in mission or personnel.

c. The severe climatic conditions and operational requirements for extreme cold weather call for a design that is basically different than either temperate and hot weather missions and, thus, require a special frame and pack independent of the more general all purpose modular system described herein. The current Field Pack Large, Internal Frame loadcarrying equipment, with certain improvements, represents the type of system required.

d. The proposed system must include considerations for the surveillance threats in terms of visual and infrared detection and noise detection. There is a need for the system to also counter physiological stresses such as fatigue and heat strain by providing optimum ergonomic design for load placement and mission performance.

#### 3. PROJECTED USE/BASIS OF ISSUE.

The modular load-bearing equipment system shall replace the medium and large ALICE packs and frame system for all but

climatic categories C2 and C3 (Cold and Severe Cold). Authorization shall be in accordance with the replacement items in Common Table of Allowances 50-900. Priority of fielding shall be to dismounted infantry and the dismounted soldiers who support them.

4. DESCRIPTION. The MLS shall provide the user with required characteristics as described below. The load-bearing system shall consist of sub-elements or modular components that will allow for rapid reconfiguration from full deployment loads to individual light fighting loads.

a. The minimum system configuration (lightest) shall be a Tactical Load Bearing Vest (TLBV) for carrying a pistol, grenades, ammunition, compass, canteens, E-tool and first aid kit. An example of such a system is the current Individual Tactical Load Bearing Vest. The proposed system shall be compatible with other load-bearing items and shall be designed to minimize heat stress. It is desired that this component also function as the support system for an external frame which may or may not have suspenders or a belt of its own. Therefore, adaptive padding for the TLBV must be sufficient for carrying heavy loads.

b. The TLBV shall provide space for at least six, thirty-round magazines in four detachable ammunition pockets and two grenade pockets.

c. An Assault/Patrol Pack shall be part of the system to provide extended capabilities by accommodating additional items such as more ammunition, food, extra clothing and protective gear. This pack shall have the capability of being worn independent of the main pack and frame. This component shall have the capacity and features for carrying the unit radio (SINCGARS with KY-57 and extra battery) if required by the user. The capacity of the main compartment of the assault/patrol pack shall not exceed 1500 cubic inches.

d. There shall also be an optional butt pack in the system for special operations calling for an extended fighting load beyond TLBV for use with or without assault/patrol pack or in conjunction with Main Field Pack Large. The butt pack shall have a volume of approximately 410 cu. inches.

e. The frame(s) (external) shall have a built-in or removable support shelf and straps to be used with or without TLBV support systems and without packs, for carrying special items such as 5 gallon water cans, mortar rounds, unit radio and other unique loads requiring rigid stable support of heavy items. The frame(s) may or may not have straps or belt, depending on design considerations to enhance compatibilities with other components and equipment. To be ergonomically efficient, the frame(s) or the supporting elements shall be sized or adjustable to accommodate the wide range of body sizes in the population of

intended users. These design parameters shall accommodate the 5th percentile to the 95th percentile soldier/marine. The suspension system shall have shoulder and hip padding appropriate for very heavy loads and chest (sternum) straps for stabilizing loads.

f. The Main Field Pack Large (MFPL) shall consist of a primary existence compartment and detachable pockets/pouches for missions involving movement on foot over extended time periods and distances. This component shall also be designed to allow the efficient carrying of the unit radio (SINCGARS with KY-57 and extra battery) when required. There shall be a lower compartment for placement of a sleeping bag or other extended mission items (volume of main and lower compartments shall not exceed a total of 4500 cu. in.). In addition to top loading, an alternate access to the main pack shall be provided on the sides or as part of the lower compartment.

g. Main compartments of packs shall have internal compression/tie down straps.

h. The main pack, compartments, all pockets and pouches shall have drain holes.

i. All snaps and fasteners shall open quickly, quietly, and be easy to use. These features shall also be resistant to dirt and damage. There shall be cinching straps for reducing excessive pack movement.

j. Outside pouches/pockets shall be sized to accommodate special equipment such as rain suits, ponchos, NBC gear, maps, notebooks, extra clothing and/or food items.

k. It is desired that the main pack and frame have a single point quick release for emergency dropping of the main load but still allow the fighting vest to be worn. It is also desired that the assault/patrol pack quickly release from the main pack and be quickly re-attachable to the fighting vest or worn independently.

l. Hip belt, lumbar support and shoulder straps shall be well padded and be quickly and easily adjusted for changes in waist size and back and shoulder lengths due to the donning and doffing of protective clothing and equipment.

m. It is desired that adjustment straps or cords be provided that allow dynamic shifting of the load for the purpose of reducing muscle strain during prolonged marches.

n. All components of the load bearing system shall be compatible with each other with the elimination of multiple straps and belts and the integration of items hung or worn on the suspension system. In addition, the MLS shall be designed to be

compatible with the body armor systems used by infantry soldiers (MOS 11B).

o. In full load configuration the system shall be airborne deployable by a single point release. The system must also be compatible with all individual airborne equipment items.

p. The main pack, assault pack, butt pack, compartments, pouches and pockets shall be "rain resistant" (water repellent) and have waterproofing capabilities (e.g., liner inserts) to keep contents dry during river and other water crossings.

q. A fully loaded system shall be durability tested to withstand full test load of 120 lb and dropped from eight feet onto a hard surface without tearing of seams, breakage of fasteners or the deformation of the frame.

r. System shall have a service life of 120 days of field use. It shall be easily field repairable with a minimal requirement for tools and spare parts.

s. System shall be rot- and mildew-resistant and have a shelf life of not less than five years.

t. System shall be chemical decontaminable to the same extent as the current LBE.

u. Main pack shall have a method for attaching items such as the E-Tool, two-quart canteen, and mattox.

v. System must be configurable to accommodate the specialty needs of medics, grenadiers, radio telephone operators and mortarmen.

w. Frame and pack design shall allow the wearer's head to flex in the ventral-dorsal (front-back) plane while wearing the helmet so as to allow such actions as rifle aiming while the individual is in a prone position.

x. Additional features desired include carry handles and interior and exterior ID name/unit tabs or slots for each pack in the system.

## 5. MANPRINT.

a. Manpower Assessment. Organizational structure shall not change.

b. Personnel Assessment. The new system is expected to accommodate current and future personnel changes provided it can adjust to different body sizes. An adjustable system is not expected to have an impact on personnel assignments nor require special selection procedures based on anthropometry.

c. Training Assessment. There shall be minimal changes in training for learning to use the new load-bearing system. Training shall emphasize the new capabilities of the system (modular re-configurations) and highlight proper care and maintenance.

d. Human Factors Engineering. The system shall be designed to adjust to fit the 5th percentile to the 95th percentile of the soldier/marine population based on critical chest, shoulder, back, hip and waist measurement dimensions. The system shall be easily operable by all personnel with minimal instruction and training.

e. System Safety. Major risks involve the catching of the system and loaded equipment on the egress or other features of vehicles or on bushes, branches and other objects in the environment. Training instruction should include the physical dangers of overloading the human body. Lessons learned from predecessor systems should be used to reduce or eliminate safety risks.

f. Health Hazard. There are no known health hazards over and above the existing load carrying equipment if materials used are the same.

6. RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM). Projected mean-time-between-operational-mission-failure (MTBOMF) must equal or exceed the current ALICE-Large load carrying system.

7. PRIORITIZED REQUIREMENTS. The following requirements are desired and shall be considered during the system's evaluation. Desired requirements are in a prioritized order.

a. Modularization for maximum operational flexibility and load configuration.

b. Strength of modular components under heavy loads.

c. Compatibility of system with other clothing and equipment.

d. Compatibility of system with airborne equipment.

e. Water-repellency (rain resistance) and waterproofing.

f. Reduction of heat stress potential.

g. Adjustability and sizing for optimizing fit.

h. Single point rapid release of main components.

i. Comfort and stability with heavy loads.

j. Camouflage and reduction in noise.

k. Total weight of system (empty).

8. OPERATIONAL/ORGANIZATIONAL CONCEPT. The MLS will be worn in combat and in peace time by nearly all soldiers and marines. The dismounted soldier has the greatest need for a load-bearing system since many mechanized and support personnel have access to vehicles for carrying their equipment.



APPENDIX C  
"MUDDY BOOT" PARTICIPANTS





APPENDIX C  
 "MUDDY BOOT" PARTICIPANTS  
 FORT BENNING, GA  
 13-16 September 1994

**TEAM 1**

Gary Downs	E-7	TSM-Soldier, Ft. Benning, GA
Richard Flowers	E-7	Ft. Campbell, KY
Fred Patterson	E-7	USMC Division School
Rios Reynaldo	E-7	Ft. Lewis, WA
Andre Williamson	E-6	63rd EN, Ft. Benning, GA

**TEAM 1 ADVISORS**

CPT. Al Borgardts	ASCD, Natick, MA (facilitator)
Seth Aitken	Student/Cadet Natick, MA
Everett Harman	ARIEM/Natick, MA
SGT Joe Jones	USAIS, Ft. Benning, GA
John Kirk	SurD, Natick, MA
Richard Landry	USASOC Liaison, Natick, MA
Gerry Raisanen	ASCD, Natick, MA

**TEAM 2**

David Gouchoe	E-8	Mt. Warfare School
Randall Kaminsky	E-7	USASOC
Enrique Montana	E-7	Ft. Campbell, KY
Anthony Pusateri	O-3	ARIEM/Natick, MA
Charlie Robertson	E-9	TSM-Soldier Ofc, Ft. Benning, GA
Paul Slaton	E-6	Ft. Hood, TX
Jim Williams	O-3	USMC/Quantico, VA

**TEAM 2 ADVISORS**

James Sampson	S&TD, Natick, MA (facilitator)
D. Paul Leitch	ASCD, Natick, MA
Keith Schroeder	MobD, Natick, MA
Dave Tucker	ASCD, Natick, MA



APPENDIX D

CHECKLIST FOR EVALUATION OF LOAD BEARING SYSTEMS



APPENDIX D  
CHECKLIST FOR EVALUATION OF LOAD BEARING SYSTEMS

Durability/Strength  
Repairability/Maintenance  
Capacity: Main Pack  
Capacity: Patrol Pack  
Capacity: Fighting Vest  
Water Proofness  
Compartment features  
Shoulder padding  
Hip padding  
Back/Lumbar padding  
Sizing/Fit  
Adjustability overall for fit  
Adjustability of belt  
Noise avoidance  
Clean-ability  
Adaptability for mission  
Quick release  
Fasteners  
Strength under load  
Stability under load  
Adjustability while carrying  
Decon-ability  
Firing Weapon Prone with full load  
Compatibility with Flak Jacket  
Compatibility with Chemical Suit  
Airborne Jumpable  
Shelf Life (+5 yrs)  
Service Life in the field (120d)  
Chest straps for stability  
Water drainage of compartments, pouches, & pockets  
Don/Doffing, ease  
Rot and Mildew Resistance  
Configurable/Modifiable vs Separate System for Medics  
Configurable/Modifiable vs Separate System for Grenadiers  
Configurable/Modifiable vs Separate System for Mortarmen  
Configurable/Modifiable vs Separate System for Gunners (M60)  
Configurable/Modifiable vs Separate System for Cold Wthr Ops  
Pouch/pocket features (number, sizes, placement)  
Frame features (adjustability, contouring, strength test)  
Configurations relative to Body Armor, NBC Suits (under/over)  
Minimum configuration: Belt & Suspenders and/or fighting Vest  
Fighting Vest features



APPENDIX E  
LOAD BEARING EQUIPMENT QUESTIONNAIRE





\*\*\*\*\*  
 LOAD BEARING EQUIPMENT QUESTIONNAIRE  
 \*\*\*\*\*

BACKGROUND

DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_  
 MM DD YY

Your Unit: CO \_\_\_\_\_ BN \_\_\_\_\_ BDE \_\_\_\_\_ DIV \_\_\_\_\_

Location Unit's Main Base (Post): \_\_\_\_\_

Your Rank: E- \_\_\_\_\_ O- \_\_\_\_\_ WO- \_\_\_\_\_ Current MOS/Specialty: \_\_\_\_\_

Years/Months in MOS/Specialty: \_\_\_\_\_ Yrs \_\_\_\_\_ Months

Previous or Secondary MOS/Specialties: \_\_\_\_\_

Gender: Male : Female Age: \_\_\_\_\_ years Years of Military Service: \_\_\_\_\_

Height: \_\_\_\_\_ ft. \_\_\_\_\_ in. Weight: \_\_\_\_\_ lbs.

Have you ever served in combat? Yes : No

If Yes, when/where? \_\_\_\_\_

QUESTIONNAIRE

1. INDICATE (CIRCLE) AMOUNT OF MILITARY FIELD EXPERIENCE YOU HAVE HAD IN EACH OF THE ENVIRONMENTS BELOW:

0 = NONE (No Military Field Experience)

| 1 = A LITTLE - (few days)

| | 2 = SOME - (a week or two)

| | | 3 = MODERATE - (a month or more)

| | | | 4 = A LOT - (many months to years)

| | | | |  
 v v v v v

0 : 1 : 2 : 3 : 4 - DESERTS IN EXTREME HEAT (NTC Ft. Irwin, 29 Palms, Saudi Arabia, etc.)

0 : 1 : 2 : 3 : 4 - DESERTS WHEN COLD (NTC, 29 Palms, Saudi during winter season and nights)

0 : 1 : 2 : 3 : 4 - TROPICAL OR JUNGLE ENVIRONMENTS (HUMID) (Panama, Grenada, Okinawa, etc.)

0 : 1 : 2 : 3 : 4 - VERY WET/RAINY ENVIRONMENTS (Ft. Lewis, Germany, etc.)

0 : 1 : 2 : 3 : 4 - COLD-WET & SNOWY ENVIRONMENTS (Ft. Drum, Bridgeport, CA, Minnesota, Norway, Germany, etc.)

0 : 1 : 2 : 3 : 4 - EXTREME COLD (ARCTIC-LIKE) ENVIRONMENTS (Canada, Alaska, Minnesota, Vermont, Norway, etc.)

0 : 1 : 2 : 3 : 4 - HIKING/CLIMBING IN HIGH MOUNTAINS (Bridgeport, CA, Colorado, Germany, etc.)

0 : 1 : 2 : 3 : 4 - PARACHUTE FROM AIRCRAFT

(Continued)

---

2. INDICATE (BY CIRCLING) AMOUNT OF EXPERIENCE YOU HAVE HAD WITH LOAD CARRYING EQUIPMENT LISTED BELOW  
(SEE DRAWINGS, BELOW):

---

0 = NONE (no experience with)

| 1 = A LITTLE - (few days or times)

| | 2 = Some - (a week or two)

| | | 3 = Moderate - (a month or more)

| | | | 4 = A LOT - (many months to years)

| | | |  
v v v v v

0 : 1 : 2 : 3 : 4 - H-HARNESS WITH CARTRIDGE BELT (MARINES)

0 : 1 : 2 : 3 : 4 - BELT AND SUSPENDERS (ARMY 'WEB' GEAR)

0 : 1 : 2 : 3 : 4 - LARGE COMBAT FIELD PACK WITH EXTERNAL METAL FRAME (LARGE ALICE)

0 : 1 : 2 : 3 : 4 - MEDIUM COMBAT FIELD PACK, WITH EXTERNAL METAL FRAME (Medium ALICE)

0 : 1 : 2 : 3 : 4 - MEDIUM COMBAT FIELD PACK, WITHOUT EXTERNAL METAL FRAME (Medium ALICE)

0 : 1 : 2 : 3 : 4 - METAL FRAME (ALICE Frame) WITHOUT PACK, (used to carry special items)

0 : 1 : 2 : 3 : 4 - THE NEW FIELD PACK, LARGE, INTERNAL FRAME (FPLIF) with detachable Patrol Pack (the Lowe)

0 : 1 : 2 : 3 : 4 - TACTICAL VEST: NEW TACTICAL LOAD BEARING VEST (TLBV) with fixed grenade/ammunition pouches.

0 : 1 : 2 : 3 : 4 - OTHER LOAD BEARING EQUIPMENT (name or describe): \_\_\_\_\_

---

LARGE & MEDIUM PACKS  
EXTERNAL FRAME (ALICE)

NEW FIELD PACK LARGE  
INTERNAL FRAME (FPLIF)  
WITH PATROL PACK

(Continued)

---

3. INDICATE [x] ITEMS YOU HAVE CARRIED ON YOUR OWN BODY DURING COMBAT OR A TRAINING EXERCISE MARCH.

---

- |  |  |
|--|--|
| <input type="checkbox"/> M60 Machine Gun                         | <input type="checkbox"/> AN/PVS-5 Night Vision Goggle (2 tubes)    |
| <input type="checkbox"/> Extra Ammunition (M60 MG)               | <input type="checkbox"/> AN/PVS-7 Night Vision Goggle (1 tube)     |
| <input type="checkbox"/> M2 .50 Cal Machinegun and/or parts      | <input type="checkbox"/> AN/PVS-4 Sight, Night Vision              |
| <input type="checkbox"/> M60 MG Tripod & spare barrel            | <input type="checkbox"/> Flak (Ballistic) Vest (Kevlar or Nylon)   |
| <input type="checkbox"/> M16/203 Rifle/Grenade Launcher (GL)     | <input type="checkbox"/> NBC Mask (M17 or M40)                     |
| <input type="checkbox"/> Extra Ammunition for M203 GL (40mm)     | <input type="checkbox"/> NBC Overgarment/gloves/boots/NBC bag      |
| <input type="checkbox"/> SAW (M249) Automatic Weapon             | <input type="checkbox"/> Extreme Cold Weather Clothing             |
| <input type="checkbox"/> Bipod for SAW (M249)                    | <input type="checkbox"/> Cold weather gear, skis, snow shoes, etc. |
| <input type="checkbox"/> Extra Ammo for SAW (100rds)             | <input type="checkbox"/> Map case                                  |
| <input type="checkbox"/> Extra Ammo for SAW (200rds) (drum)      | <input type="checkbox"/> Medic's bag/Corpsmen bag                  |
| <input type="checkbox"/> Aiming stakes                           | <input type="checkbox"/> Stretcher                                 |
| <input type="checkbox"/> Binoculars                              | <input type="checkbox"/> Mechanic's Tool Box                       |
| <input type="checkbox"/> JAVELIN and/or components               | <input type="checkbox"/> E-Tool                                    |
| <input type="checkbox"/> AA DRAGON MISSILE and/or components     | <input type="checkbox"/> Unit shovel                               |
| <input type="checkbox"/> Unit Radio AN/PRC-77 or -119 (SINCGARS) | <input type="checkbox"/> Pick axe                                  |
| <input type="checkbox"/> Squad Radio AN/PRC-126 or -68           | <input type="checkbox"/> Shelter half or crew tent                 |
| <input type="checkbox"/> Radio AN/PRC-113 or RC-292              | <input type="checkbox"/> AT/AP mines                               |
| <input type="checkbox"/> AT4 Weapon and/or components            | <input type="checkbox"/> Claymore mine                             |
| <input type="checkbox"/> 5 GAL fuel or water cans                | <input type="checkbox"/> LAW AA weapon                             |
| <input type="checkbox"/> Mortar 60mm (M224) and/or components    | <input type="checkbox"/> Wire reel (e.g. DR-8)                     |
| <input type="checkbox"/> Ammunition for 60mm mortar              | <input type="checkbox"/> Ranger finder                             |
| <input type="checkbox"/> Mountain climbing gear                  | <input type="checkbox"/> MILES equipment                           |
| <input type="checkbox"/> Grappling hooks                         | <input type="checkbox"/> Shotgun                                   |
| <input type="checkbox"/> Rope                                    | <input type="checkbox"/> Bangalore torpedo section                 |
| <input type="checkbox"/> Demolition kit                          | <input type="checkbox"/> First Aid Kit                             |
| <input type="checkbox"/> Field phones TA-1 or TA-312             | <input type="checkbox"/> Compass                                   |
| <input type="checkbox"/> 2qt canteen                             | <input type="checkbox"/> 1qt canteens (more than one)              |

List other difficult-to-carry items you have carried::

- |                                |                                |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |

☐ ESTIMATE THE WEIGHT OF ONE OF YOUR TYPICAL HEAVY LOADS: \_\_\_\_\_ lb

Notes/Comments:

(Continued)

---

4. INDICATE (CIRCLE) WHETHER YOU AGREE OR DISAGREE WITH THE COMMENTS BELOW ABOUT THE  
LARGE COMBAT PACK WITH EXTERNAL FRAME (ALICE) SYSTEM.

---

(If you have not used ALICE skip to next question)

? = Can't Say

SA = Strongly Agree

A = Agree

N = Neither agree nor disagree

D = Disagree

SD = Strongly Disagree

**LARGE COMBAT PACK WITH EXTERNAL FRAME (ALICE):**

(NOTE: check here \_\_\_\_ if you are answering for MEDIUM Pack only):

- ? : SA : A : N : D : SD - In many cases NOT enough room in pack
- ? : SA : A : N : D : SD - Too much room in pack, encourages overloading
- ? : SA : A : N : D : SD - It needs a detachable patrol pack
- ? : SA : A : N : D : SD - Bring back the butt-pack
- ? : SA : A : N : D : SD - Metal Frame not durable enough
- ? : SA : A : N : D : SD - Metal Frame should adjust for body size
- ? : SA : A : N : D : SD - Metal Frame should come in more than one size
- ? : SA : A : N : D : SD - Pack not durable enough
- ? : SA : A : N : D : SD - Not enough padding, uncomfortable
- ? : SA : A : N : D : SD - Needs more padding in shoulder area
- ? : SA : A : N : D : SD - Needs more padding in hip area
- ? : SA : A : N : D : SD - Needs more padding in back area (kidney pad)
- ? : SA : A : N : D : SD - Too many straps
- ? : SA : A : N : D : SD - Fasteners/keepers not durable enough
- ? : SA : A : N : D : SD - Front buckle not durable
- ? : SA : A : N : D : SD - Frame holds load away from body, great for warm climates.
- ? : SA : A : N : D : SD - Needs more room for cold weather missions
- ? : SA : A : N : D : SD - External Frame provides good stability for heavy loads
- ? : SA : A : N : D : SD - Airborne jumpable
- ? : SA : A : N : D : SD - Metal Frame with shelf good support for radio (e.g., PRC-77 or PRC-119)
- ? : SA : A : N : D : SD - Metal Frame with shelf good support for 5 gal cans
- ? : SA : A : N : D : SD - I didn't know the metal frame had detachable shelf
- ? : SA : A : N : D : SD - Cannot drop the approach march load quickly enough when needed
- ? : SA : A : N : D : SD - We need a new combat belt system
- ? : SA : A : N : D : SD - Cannot balance canteens very well
- ? : SA : A : N : D : SD - Cannot balance E-Tool very well
- ? : SA : A : N : D : SD - Large pack needs better outside pockets/pouches
- ? : SA : A : N : D : SD - Can't fire weapon from prone position while wearing pack
- ? : SA : A : N : D : SD - Not compatible with new tactical vest (load bearing vest)
- ? : SA : A : N : D : SD - Not compatible with flak vest (Kevlar/Nylon)
- ? : SA : A : N : D : SD - Not compatible with M203 grenade vest
- ? : SA : A : N : D : SD - Not compatible with Medic/Corpsmen items (Aid Bag, etc.)

---

Additional comments on External Frame Pack system:

(Continued)

---

5. INDICATE WHETHER YOU AGREE OR DIAGREE WITH COMMENTS BELOW ABOUT THE NEW  
FIELD PACK LARGE, INTERNAL FRAME (FPLIF) (LOWE) SYSTEM.

---

(If you haven't used INTERNAL Frame Pack, go to next question)

? = Can't Say

SA = Strongly Agree

A = Agree

N = Neither agree nor disagree

D = Disagree

SD = Strongly Disagree

**Field Pack Large, Internal Frame (FPLIF)(Lowe):**

- ? : SA : A : N : D : SD - Extra room in pack good; needed for cold weather missions  
? : SA : A : N : D : SD - Too much room in large pack, encourages overloading  
? : SA : A : N : D : SD - Pack not durable enough  
? : SA : A : N : D : SD - Heavy objects dig into back  
? : SA : A : N : D : SD - Too many straps  
? : SA : A : N : D : SD - Not compatible with butt pack  
? : SA : A : N : D : SD - Fastners are not durable enough  
? : SA : A : N : D : SD - Adjustability to different body sizes a good feature  
? : SA : A : N : D : SD - Too complex to adjust  
? : SA : A : N : D : SD - Front buckle not durable  
? : SA : A : N : D : SD - Pack next to body too warm in hot weather  
? : SA : A : N : D : SD - Internal Frame less stable than ALICE (External) frame  
? : SA : A : N : D : SD - Center of Gravity good, helps when skiing or snow shoeing  
? : SA : A : N : D : SD - Ruck Length too long for Airborne deployment  
? : SA : A : N : D : SD - Pack not well designed for carrying Radio (PRC-77 or 119)  
? : SA : A : N : D : SD - Cannot carry 5 gal water/fuel cans with it  
? : SA : A : N : D : SD - Cannot quickly drop marching load when needed  
? : SA : A : N : D : SD - Doesn't work well with web belt  
? : SA : A : N : D : SD - Can't balance or carry canteens very well  
? : SA : A : N : D : SD - Can't balance or carry E-Tool very well  
? : SA : A : N : D : SD - Can't fire weapon from prone while wearing full pack  
? : SA : A : N : D : SD - Not compatible with new tactical vest  
? : SA : A : N : D : SD - Not compatible with ballistic (Kevlar/Nylon) Flak vest  
? : SA : A : N : D : SD - Not compatible with M203 grenade vest  
? : SA : A : N : D : SD - Not compatible with Medic/Corpsmen items (Aid Bag etc.)  
? : SA : A : N : D : SD - Detachable patrol/assault pack great idea  
? : SA : A : N : D : SD - Outside Pocket features well designed  
? : SA : A : N : D : SD - Lower sleeping bag compartment very useful

---

Additional comments on Internal Frame system:

(Continued)

---

**6. ADDITIONAL QUESTIONS:**

---

a. If you have used the metal frame and shelf to transport large items, how is the rest of your gear carried? (If this does not apply to you skip to next question)

---

---

b. Do pouches on your equipment belt get in the way of waist belt of your field pack? YES : NO

---

---

c. What sort of things do you put into (or would like to put into) pockets/pouches on the large pack?

---

---

d. Of all the jobs in your unit, who has to carry the greatest loads?

---

---

e. When and where are Soldiers/Marines most likely required to carry their heaviest loads (e.g., during initial deployment, cold weather ops without resupply etc.).

---

---

f. Do you frequently leave your hip belt open, unattached? YES : NO (If YES explain why)

---

---

g. What problems do you have wearing your Flak Vest (Kevlar) with your load bearing equipment?

---

---

h. Should your BODY ARMOR (Flak Vest) have pockets or pouches to carry items for your fighting load?

---

---

i. Would you prefer that your flak vest body armor and load bearing equipment be made into one system

---

(Continued)

---

---

---

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slightly textured appearance and some minor blemishes or dust specks. The edges of the paper are slightly irregular.

(fea\_q2.ws) 14 JUNE 94





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